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JULY, 1847.

CIVIL ENGINEERING.

Third Annual Report of the South Carolina Railroad Company.

Gentlemen,—The Board of Directors have the honor of presenting to the stockholders their third annual Report of the operations of the South Carolina Railroad Company, for the year ending the 31st of December, 1846.

The gross receipts for freight, passengers, and mail service, for the year 1845, were	$558,697·71
The expenditures for same period, embracing ordinary current expenses, additional machinery, improvements on depot, and interest on foreign and domestic debt, were - - -	389,148·10
	169,549·61
Amount of dividends paid,	147,900·00
Balance applied to improvement of property,	21,649·61

From the above, two semi-annual dividends of $2·25 and $2, making $4·25 on each share was declared, being within a fraction of 5½ per cent. on the par value, 75 dollars, of the road stock, and leaving, as shewn, $21,649·61 applicable to the objects as stated.

The gross receipts from all sources for the year 1846, were,	$ 589,081·25
The expenditures for same period, including current expenses, additional machinery, improvements on depot, interest account, paving Meeting street, and damages, were - -	418,171·17
	170,910·35
Amount of dividends paid, - -	140,725·50
Balance applied to improvements of property and reduction of indebtedness,	$ 30,184·85

The two semi-annual dividends were, for the first half year, $1·50, and the last $2·50, making $4 on each share, and equivalent to 5⅓ per cent. on par value of stock, and leaving, as exhibited, $30,184·85 applicable to improvements. The large amount under the general head of expenditures for the year 1846, as compared with those of the previous years of 1844 and 1845, may be explained by an appropriation for the improvement of Meeting street, and for damages: particularly in the loss, from fire, (supposed to be the act of an incendiary,) of a large amount of cotton, while in the cars on the track at Aiken, ready for departure by the downward train the next morning. If these amounts (as in the Auditor's comparative statement of ordinary expenses, since the consolidation of the two companies,) be deducted, we have for the legitimate and unavoidable expenditures, under all the various heads of current, materials, property and interest account, $282,972·31 in the year 1844, $279,475·43 for 1845, and $300,672·22 for 1846—shewing, as compared with 1844, an excess of expenditure of $17,699·91, against an increased receipt of $56,210·57; and, as compared with the last or previous year, an excess of $21,196·79 of expenditure against $30,383·81 of increased receipts. A considerable portion of this excess of expenditures may be accounted for in the enhanced cost of supplies; in the large amount of materials on hand; (as exhibited in the schedule from the master of the workshops;) in preparation for the construction of an additional number of cars; and in the increased expense necessary to preserve the track of the Hamburg road from the injuries inflicted by the heavy locomotives, and the higher speed of the passenger trains. The relative proportion likewise between the receipts and expenditures this year, were greatly disturbed by the low rate (with a view of relieving the suffering planters of the interior) at which the Company undertook to transport grains.

Upwards of 250,000 bushels of corn alone, the last season, were transported to Columbia, Hamburg, and intermediate stations; and at the moderate rate of freight charged, *a portion of it free*, it is apparent that much the largest moiety of the amount was made chargeable in the columns of expenses, while a very small balance was carried to the credit side of receipts. The receipts of the first half year of 1846, which were greatly affected by the reduced crop of 1845, had like-

wise an influence in disturbing the relative proportions between receipts and expenditures, for, by reference to the Auditor's accounts, it will be seen that of the amount, $589,081·52, received for the year 1846, but $251,741·36 were taken in the first half year, while the last half year, the receipts were swollen to $337,340·16; and under such a pressure on our locomotives, cars, and available force, as unavoidably to involve greater expense from the necessity of loading cars and running the trains at night.

The report of the Auditor, with the accompanying tabular statements, numbered from 1 to 7, exhibits, in a clear view, the state and condition of the property and finances of the Company, with its liabilities, assets, &c., for the year 1846; and of the monies received and expended on account of the stock, and on the construction of the Camden Branch Road. The tabular statements, Nos. 4, 5, and 7, exhibit the number of passengers conveyed on the road, the amount of freight, separating that which goes into, from that which comes from the interior, the number of bales of cotton received at each station, the number of packages and pieces of merchandize forwarded by railroad into the interior, and the amount of articles received by railroad for transmission to other places, with a comparative statement, in table No. 7, of the income of the road for the last three years, (commencing with the consolidation,) from all sources, exhibiting the average number of locomotives in active service, their arrivals and departures, with the number of miles run. Appended to these documents, is a statement for the last three months of the year, commencing with the more recent extension of the lines of railroads to the west; from our agent in Hamburg, of the number of packages of merchandize, with the value of the freight thereon, forwarded to the different stations beyond Atlanta in Georgia, where the trade with North Alabama, the Coosa District, and Eastern Tennessee may be said to commence, with an exhibit of the returns of the same in cottons, grains, western productions, and domestics. From these beginnings of a trade just emerging from the western horizon, the extent of which in the future cannot be estimated, and must greatly exceed even the speculations of the most sanguine—the stockholders will be the better judge of the facilities, which it is for the interest of this Company to continue to afford. In connecting the forwarding with the other obligations of common carriers, your direction have been influenced, not merely by the example and practice of other companies competing for the same business, but with a view of so cheapening and of so perfecting the means of transportation as to bring not only contiguous points, but even those the most remote, in certain and intimate communication with each other, thus augmenting the transportation on the road as the ranges and circles of commercial intercourse were extended, diverting to, and through Charleston, merchandize and produce which hitherto sought the markets of consumption by other channels; and into which they would still continue to flow, if equal and greater facilities were not afforded by what is now known and designated as the Carolina and Georgia route to the West. The policy pursued has not been without its favorable results on the transactions

on the road. As this matter, however, was referred to a committee to report on, your Board do not consider any further remarks necessary beyond the presenting on this occasion, statements and facts for the determination of the maturer judgment of the stockholders.

The report of the Superintendent of the road, Mr. Lithgoe, is not as favorable as your direction could have desired. His statements, which have been confirmed by the inspections of the President, are: That the track, from the very light iron rail in use on the Hamburg portion of the road, is beginning to suffer from the heavy freight trains and locomotives which the increased business has now rendered indispensable. The greater number of passengers in the daily trains, and the higher speed exacted under contract for mail service, and to meet the competition of other traveled routes, have likewise conspired to produce similar injurious effects. The iron rail is wearing daily, and in some instances has become so thin, (though of the flanch form,) as to be very little superior to the common flat bar, which the South Carolina Canal and Railroad Company found necessary, at a former period, to remove. This subject, in part, was brought to the notice of the stockholders in the last annual report, and the recommendation of importing a certain amount of new rails annually, to be substituted for those which were impaired, met with your concurrence; —subsequent experience, however, affording more time for examination, and which accords with that of other railroad companies in Europe and the United States, who, in the first instance, used rails of a moderate weight on their tracks, with the views communicated by Mr. Lithgoe, (under whose daily inspection is brought the effects of heavy weights in rapid motion on a light superstructure,) would favor the policy of preparing, at an early date, for the gradual substitution of five or ten miles annually of a heavier—for the flanch rail now in use, to the extent, at least, of the main trunk of road from Branchville. This trunk, 62 miles in extent, now sustains the business of both the branches to Columbia and Hamburg, and will soon have added that of the Camden and other roads now projected, with the view of a connexion with the South Carolina. Promptness of execution, certainty, and security are the strong recommendations of railways, and if they are not so constructed as to ensure these requirements by the public, the transportation on them will diminish, or be executed without satisfaction, with frequent interruptions, and at great hazard. The stockholders of the Baltimore and Ohio Company, the road of which was constructed, on the lower section from Harper's Ferry, with a light flat bar, have commenced the substitution of an iron rail of a heavier and more serviceable weight; and the able report of its Engineer, accompanied with valuable statements and calculations of the injury inflicted on iron rails, according to the velocity and amount of tonnage transported periodically over them, demonstrates *that in the greater annual expense of maintaining a track with a light rail, the Company, in the course of time, will be amply remunerated for the larger capital, which, in the first instance, a rail of heavier weight will involve.* The experience on that road, which, in all its operations, is more assimilated to those of the South

Carolina than any more to the north of it, but made more apparent from the heavier amount of tonnage transported than the South Carolina has as yet attained, has been amply confirmed by the report of Mr. Lithgoe. While the maintenance of way on the Columbia Road, constructed on cross-ties, and with a T rail of 57 pounds to the yard, (though the timber of a considerable portion of the lower section had to be removed,) does not exceed 160 dollars to the mile—that on the Hamburg Road has amounted to 351 dollars—and even at this cost the superstructure, in many places, has with great difficulty been preserved in the condition that the interests of the Company prescribes. "The present iron," says the Superintendent, "imbeds itself in the timber, so much so, that the timber has to be removed more from this cause than from decay. I am of the decided opinion that the timber in which the iron lays, on an average, will not last longer than three years. If this be the result, is it not a matter for consideration whether it would not be better at once to adopt a heavier iron?" While on this subject of defect in the road, and of the remedy necessary, is brought to the attention of the stockholders, it is with some satisfaction that the Board have to charge the injury sustained and complained of to an increased and continually increasing business, which, in requiring a superstructure equal in strength to the tonnage daily exerting its weight and power on it, furnishes, in the increased profits of transportation, the adequate means to renew the road, in sections, gradually as proposed.

The enhanced expense in the maintenance of way, of a superstructure too light and too fragile for the weight and velocity of the machines it has to resist, forms but a small portion of the injuries otherwise sustained, in all the varied operations of the road. If the track is weak and defective, and subjected to repeated dislocations, accidents accumulate; delays in the arrival of trains, involving loss of time, become more frequent; damages and forfeitures are oftener incurred; and the injury to machinery in locomotives of a delicate texture and easily deranged becomes incalculable. In a heavy superstructure, therefore, and a firm, unyielding road-bed, is reliance alone to be had for a perfect railway; adapted to any emergency, and equal to any power or velocity which it may be desirable to apply on it. This subject, therefore, is submitted to the serious consideration of the stockholders, that they may either, by a committee reared for this special purpose, examine into, and devise the means necessary to remedy the approaching difficulties, in the defect of road anticipated, or devolve on our successors in office ample power to act in the premises as the interests of the Company may recommend. The procuring the labor necessary and required on the different sections of road, by hiring at fair rates, is another difficulty presenting itself. "After hands," says the Superintendent, "for many years in the Company's service, have acquired the knowledge and skill necessary to make them valuable, the Company are either compelled to submit to higher rates of wages imposed, or to pass others, at a lower rate of compensation, through the same apprenticeship, with all the hazards of another strike, in their turn, by the owners." This difficulty involves the advantages of the policy

of owning by purchase, the labor necessary for service on the road, or to continue to be exposed to all the hazards of hiring under the present system, and the chances of being raised upon in times of emergency. Mr. Lithgoe reports that ten women and seventy-five young men may be advantageously and profitably employed in the place of many of those now hired; the wages paid for whom would be a high remuneration to the Company for the capital so invested. All of which views are respectfully submitted to the consideration of the stockholders.

The report of the master of the workshops, and of the agent of transportation, exhibits the state and condition of the property in machinery, the number of cars on hand, the number of locomotives in service and their present value, the number of those disabled but susceptible of repair, and the number which, from age and hard usage, are unfit for renewal, though portions of their parts may be worked up in other machinery—and the additional number of both cars and locomotives which will be necessary to meet the pressing demands of a constantly increasing business to the satisfaction of the community to be accommodated. This report is very satisfactory as to the service which has been rendered the last year by the Company's locomotives, the number of miles performed, and the proportional number of engines, compared with the entire number owned by the Company, which have been kept in repair and on active duty. It is believed that the performance, for the last six months of the year, with this limited power, will bear a favorable comparison with the like number and class of locomotives on any other road. With this report is a statement of the work performed at the smith shop, foundry, and car factory. These statements go far to recommend the policy of a large addition to both the Company's car and locomotive power. It is true economy never to press too severely upon machinery so easily deranged as that on a locomotive, and always to be so amply supplied. No locomotive, after performing a trip exceeding 260 miles in extent, should resume her position on the track before a thorough examination, and reported in a proper condition, by the master of the workshops. The exigencies of the business of the road, compelling the extra service of a locomotive, when disabled, or not in a proper condition, is always performed at a cost detrimental to the best interests of the Company. In England, and on all economically managed railroads, it is considered advantageous to own double the number of locomotives which the actual business of the road may require, so as to afford time for examination and reparation of all on their return trips, and to be prepared with extras for every emergency, without resorting to unprofitable expedients to meet the unexpected demands of the trade, or of a community for accommodation. *Semper Parati*, is the true motto for the guidance of all railroads, and, in accordance with its admonitions, your present directors have made arrangements for such an increase of motive power, passenger and burden cars, for the ensuing year, as will, in their judgment, meet the requirements of the road; and, with the experience which has been their guide in this case, they recommend the execution to those who may succeed them in office.

The report of the engineer, Mr. McRae, of the Camden Branch, shews the present condition and progress of that work, notwithstanding a suspension of operations the last spring for nearly two months, with a hope that the citizens of Sumter might be accommodated by a change of route in the road proposed; and the subsequent summer and winter interpositions of successive floods in the Wateree river, the work has been steadily progressing, and a hope is still encouraged that, with the powerful aid of steam, and energetic contractors, the passage of the Wateree river and swamp may yet be accomplished in time to enable the Company to press forward, with all practicable despatch, during the summer and fall months, with the superstructure to Camden. A large portion of the grading along the entire line is already completed; the whole is under contract; the wooden superstructure with the rails, between the Congaree and Wateree, are now in progress. Iron, sufficient for the completion of that section has arrived, and if the floods of the Wateree do not interpose any further obstacles than those which have already been encountered, the engineers feel confident that all the objects, as to time, in completing the road, will yet be realized. But the best devised plans, and the most powerful of human efforts have, at times, to yield to elements which are not to be controlled, and often too powerful successfully to resist.

Your Board of Directors, with much satisfaction, congratulate the stockholders on the beneficial results of that liberal policy early adopted on their part, of extending countenance and credit to all sister roads, having for common objects the bringing the western portions of our Union in more intimate social and commercial relations with those of the south. The roads in Georgia and Alabama are rapidly and successfully progressing—many of them finished—new roads, penetrating more remote, and hitherto inaccessible sections in those and the adjacent States of Mississippi and Tennessee, projected; and companies in progress of organization for immediate and successful action. The road from Chatanooga to Nashville is no longer a problem, and we have every assurance of the most energetic efforts to commence and push it rapidly to completion. The Hiwasse railroad, opening a communication to Knoxville and the interior of eastern Tennessee, has been revived, and will receive a new impulse on the completion of the Western and Atlantic to Cross Plains, now only awaiting the daily expected arrival of the iron to finish it. The interior of Alabama is looking with deep interest to a railroad communication between the Georgia and Tuscaloosa, by the Rome branch and Valley of the Coosa. Superadded to these, charters have been granted by both of the legislatures of North and South Carolina, and our people are everywhere awakening to the importance of rendering more intimate and binding, by railroads, the city of Charleston with the interior districts of our own and more northern sister.

The most gratifying symptom, however, in all these movements, is the enlightened spirit by which the projectors seem now to be influenced—repudiating all idea of monopoly, rivalry, and competition. We have witnessed with gratification, in a recent convention at Macon, indications of a desire for that concert and union, in all these en-

terprizes, by which our Southern railroads are to be considered not exclusively State works, but as a part of a common system; the veins and arteries of a great commercial body, animating in the reciprocal circulations of its trade, the whole, and paralyzing, by impediments, or restrictions, no portion. We cordially respond to views so enlightened, and so well calculated, at this time, to stimulate and bring in closer communion interests having the common object of prosperity to all.

Respectfully submitted,

JAMES GADSDEN, *President.*

Charleston, S. C., Feb. 9, 1847.

Statement of the number of Passengers conveyed upon the Railroad between Charleston, Hamburg, and Columbia, with the amount received for Freight and Passage, from 1st January to 31st December, 1846.

	PASSAGE.						FREIGHT.					
	Up.		Down.		Up and Down.		Up.		Down.		Up & Down.	Total Amount
	No. Pass.	Amount Passage.	No. Pass.	Amount Passage.	No. Pass.	Amount Passage.	Amount Freight.		Amount Freight.		Amount Freight.	Freight and Passage.
January,	2,337	7,467·76	2,012	6,391·27	4,349	13,859·03	9,389·49		9,486·65		18,876·14	32,735·17
February,	2,022	7,144·36	1,684	6,159·43	3,706	13,303·79	10,557·28		9,168·01		19,725·29	33,029·08
March,	2,576	9,083·62	2,008	7,226·18	4,584	16,309·80	20,415·93		10,192·33		30,608·26	46,918·06
April,	8,014	10,377·42	7,753	8,786·36	15,667	19,153·78	18,204·41		8,469·68		26,674·09	45,827·87
May,	2,624	8,560·47	1,973	6,350·36	4,597	14,910·83	12,908·49		9,110·01		22,018·50	36,958·33
June,	2,182	6,483·82	1,673	4,979·05	3,855	11,462·87	7,241·91		5,531·38		12,773·29	24,236·16
July,	1,866	5,341·23	1,555	4,752·85	3,421	20,094·08	7,116·38		7,166·75		14,283·13	24,377·21
August,	1,764	5,915·11	1,505	4,232·23	3,269	9,147·34	9,520·29		5,704·57		15,224·86	24,372·20
September,	2,203	7,582·69	1,421	4,205·77	3,624	11,788·46	20,916·28		10,647·32		31,563·60	43,352·06
October,	2,693	9,491·88	2,399	8,192·77	5,092	17,684·65	26,948·31		33,951·15		60,899·46	78,584·11
November,	2,748	9,806·80	2,285	8,605·24	5,033	18,412·04	16,072·77		39,796·14		55,868·91	74,280·95
December,	3,152	10,003·38	3,687	11,215·15	6,830	21,308·53	12,999·42		30,174·97		43,174·39	64,482·92
Total,	34,181	96,348·54	29,955	81,095·66	64,136	177,444·20	172,290·96		179,308·96		351,689·92	529,134·12

Received for freight and passage as above,		$ 529,134·12
" through tickets sold by Georgia Railroad Co., the past year		12,200·67
Total freight and passage,		541,334·79
" " transportation of the mails for the past year,		39,716·76
" " rents, storage, and other minor sources,		7,999·97
Total receipts for the year,		$ 589,051·52

THOMAS WARING, *Auditor.*

Statement of the number of Bales of Cotton received in Charleston, by the Railroad, from Jan. 1 to Dec. 31, 1846.

	Hamburg	Aiken.	Bl'kville.	Midway	Br'chville	Way H. R.	Tot. H.R.	Columbia	Gadsden.	Lewisville.	Orangeb'rg	Way C. B.	Total C. B.	G Tota.
January,	4,314	77	281	282	13	197	5,164	3,271	950	226	149	404	5,000	10,164
February,	4 478	31	540	242	21	83	5,395	3 829	282	240	101	860	5 292	10,687
March,	5,202	11	177	58	63	47	5.558	5,399	339	147	80	68	6,033	11 591
April,	,106	34	345	185	23	161	3,854	3,820	90	662	205	219	4,996	8 850
May,	6 849	15	53	91	78	46	7,132	4,034	371	275	65	131	4,876	12,003
June,	3,650	00	1	44	00	00	3,695	2 636	154	40	00	108	2,938	6,633
July,	6,365	33	54	00	17	5	6,474	2,205	9	145	00	258	2,617	9 091
August,	4,649	00	3	2	00	8	4,662	1 537	36	00	00	12	1,585	6 247
September,	7,229	00	15	8	56	7	7,315	3,772	190	00	00	138	4,100	11.415
October,	14,117	50	348	227	91	135	14,968	14,902	1,241	564	174	1,023	17,904	32 872
November,	18,901	88	688	332	95	920	21 024	15.112	963	731	237	476	17.519	38,543
December,	15 998	7	444	208	100	135	16,892	9,641	386	319	79	853	11,278	28,170
Total,	94,858	346	2,949	1,679	557	1,744	102,133	70,158	5,011	3,329	1,090	4,550	84,138	186,271

Statement of the number of Packages and Pieces forwarded on the railroad, (up) from 1st January to 31st December, 1846.

In January,	2,776 Pieces and Packages	from	29	Vessels.
February,	2 536	do.	do.	24 do.
March,	5,778	do.	do.	30 do.
April,	3,828	do.	do.	25 do.
May,	2,646	do.	do.	34 do.
June,	1 827	do.	do.	34 do.
July,	885	do.	do.	22 do.
August,	3,113	do.	do.	27 do.
September,	8,617	do.	do.	28 do.
October,	17,748	do.	do.	55 do.
November,	6,352	do.	do.	31 do.
December,	4,787	do.	do.	41 do.
	69 893	do.	do.	380 do.

Statement of articles received by the railroad and forwarded to other places, in the year ending 31st December, 1846.

6,822	bales Cotton,	22	bags Dried Peaches,
31	" Waste,	34	bbls. Wax and Mdze.,
619	" Yarn,	1	tierce Wax,
35	" Domestics,	6	casks Wax & Mdze.,
6	" Wool,	114	boxes Mdze.,
4	" Fur skins,	7	" Indigo
3	" Rags,	24	packages Mdze.,
22	" Pink-root, Ginseng, &c.,	10	pairs Bellows,
1,353	bags Feathers, Roots, and Wax,	7	Trunks.
	Total,	9,120	pieces and packages.

THOMAS WARING, *Auditor.*

General Statement of Receipts and Expenditures for the year 1846.

Gross receipts from all sources in first half year,		$251,741·36	
Ordinary current expenses for same time,		193,592·21	
Nett profit for the first half year,		58,149·15	
Gross receipts from all sources for the second half year,	$337,340·16		
Ordinary current expenses for same time,	224,578·96		
Nett profit for second half year		$112,761·20	
Nett profit for the year 1846,			$170,910·35
From the nett profit two dividends have been declared, making the average per cent. on the joint dividend 5¾ pr ct. on par value,			140,725·50
Leaving a nett balance, accounted for as follows, of			$30,184·85
Reduction of balance of indebtedness in the year,		$5,946·15	
Reduction of amount to debit of improvement of depots and property, including one locomotive, and charged to income account in last six months,	$11,332·78		
Paid for improvement of depots and of property, including one locomotive, in first six months,	9,634·49		
		20,967·27	
Paid for lands,		2,961·43	
Paid on account construction of Columbia Branch,		310·00	
			30,184·85
Gross receipts from all sources for the year,			589,081·52
Paid ordinary current expenses for the year,			418,171·17
Nett profit for the year,			170,910·35
Deduct two dividends,			140,725·50
Leaves a balance, accounted for as above, of			$30,184·85

Interest on sterling bonds for the year, and included in the above amount of ordinary expenses, ($418,171·17,) $108,530·05

THOMAS WARING, *Auditor.*

The Helder, or Great North Holland Canal.

At a meeting of the Institution of Civil Engineers, Feb. 28, a supplement to the papers on "the Helder or Great North Holland Canal," by Mr. G. B. W. Jackson, was read. It contained a description of the harbor and works at Nieuwediep, which might be considered as legitimately connected with the Helder canal, inasmuch as they were constructed with a view of affording shelter to vessels of war and merchantmen navigating the North sea. The banks, or shoals, situated at the mouth of the Marsdiep channel, act in a peculiar manner; they narrow the entrance, resist the undue influx of the tides, thus preventing injury to the coast of the Zuyderzee; they oppose difficulties to the entrance of hostile fleets, as the navigable channels run within range of the protecting forts; and they assist in maintaining the velocity of the currents which keep the channels at their usual depth. On the coast of Holland, the ebb-tide continues to pass off along the Noorder-gat a full hour and a half after the tide has

commenced flowing up along the Schulpen-gat; this can only be accounted for by supposing that the tide runs up from the south-west, and enters the Schulpen-gat, whilst the ebb still continues, in consequence of the draft of the tide northward along the coast. The Schulpen-gat and the Landsdiep may, therefore, be termed the flood-channels; whilst the Noorder-gat may be considered the ebb-channel. Upon these spots, whose preservation was of such consequence to the country, the Dutch have lavished their best care, and exercised their ingenuity.

The shore-works consisted chiefly of groynes, composed of timber piles and fascines, with stone covering. The average length was two hundred yards, with slopes of about one in eight or ten. In consequence of the report of the commission appointed in 1780, the engineers, Brunnings and Goudrai, were instructed to proceed with the formation of a warping bank of fascines, 7360 feet long, with double planking guard to accumulate the sand, in order to fill up the interstices of the fascines, and thus preserve them from decay. A breakwater, also, 1850 feet in length, 73 feet wide, at three feet below high water, with slopes of one to one. This was also formed of fascine beds, weighted with 2000 lbs. of stone, and 4000 lbs. of tiles upon every superficial area of 144 square feet. The upper surface was covered with matting, and made convex, the centre being one foot, and the sides three feet, below the level of high water. Hurdling was then used, and the whole was covered with blocks of stone weighing from 1500 lbs. to 1800 lbs. each. An additional length of 2080 feet was subsequently built, the warping bank being completed, and by means of these works, the ebb-stream was increased to such an extent as at once to deepen the channel eighteen inches, although the bed was of clay. In 1783, dredging was resorted to, and, with the action of the stream, a depth of nineteen feet was arrived at. The whole length of the proposed harbor was then dredged to a depth of seventeen feet under high water level. Another warping bank of 3675 feet in length was then constructed, with numerous groynes to arrest the sand, and preserve the coast. A quay-wall and jetty were then added; the piles composing the latter were covered with sheet-lead between high water level and one foot below the ground, in order to preserve them from the ravages of the *Teredo Navalis*, which, however, it is the popular opinion, may be also prevented, by driving the piles through fascines. A portion, sixty feet in length, of the breakwater was torn away by a storm; this slip was filled up with large stones, but they were ineffectual, and fascines were ultimately had recourse to for repairing the breach. The depth of the channel was thus increased to nearly thirty-five feet, so that frigates could pass with safety. In 1789, one hundred and fifty-one vessels were lying there at anchor, fourteen of which were men of war, and four were East Indiamen. The basin is 1292 feet long, and 646 feet wide, with large storehouses, dock buildings, fortifications, &c., of the most solid description, and thoroughly complete for a naval arsenal. The details of every part of the works were given. A special vote of thanks was passed to Mr. Jackson for the paper.

Remarks.—An interesting discussion ensued, in which the highest compliments were paid to the author for the paper he had presented, and the manner in which it was illustrated. A description was given of Dymchurch wall which defends Romney Marsh, an extent of 24,000 acres, and also of several other sea-defences at the mouth of the Thames, and elsewhere, in which fascines were extensively used. The Nene embankments were also described. Specimens were shown of the *Arundo Arenaria*, a coarse grass, whose roots extend sometimes to a length of upwards of thirty feet, and which is eminently useful in securing the sand of the coast from being blown or washed away.

Among several cases of the failure of protecting-walls, one was particularly described of a nearly vertical sea-wall, whose foundations were sunk down full five feet below the shingle of the coast: the wall was built with great care, and with first-rate materials—it was, however, exposed to the action of a heavy sea in North Wales. During a severe storm, the waves were thrown up in a mass full forty feet above the wall, and falling from that height, with the force due to such a distance and mass, very speedily destroyed the whole wall. In quite as exposed a situation, a slope, which enabled the waves to expend their strength, and broke them up into foam, did not suffer at all. Numerous deductions were drawn from these and many other instances, all unfavorable to the theory of vertical sea-walls, which it has recently become fashionable to recommend as a theoretically even more correct form, in opposition to the well tried plan of eminent civil engineers, who have almost universally adopted slopes for resisting the action of the sea.

March 2.—This evening the discussion upon Mr. Jackson's paper was renewed.

The comparative advantages and disadvantages of vertical and sloping sea-walls were discussed, and instances were given of the effeet of seas upon the former when walls of a certain batter or curved face, surmounted by an overhanging coping of such an extent as to deflect the curling wave outwards, and throw it back upon itself rather than allow it to fall bodily inwards, as in the case of the Penmaenmawr wall mentioned at the last meeting. The manner in which the waves were driven up long slopes, acquiring force as they traveled along, was contrasted with this. On the other hand, the action of the various kinds of waves was shown upon sections of the beach at Madras, where the surface was so notoriously bad, and where it appeared that by the clawing off of the waves the beach was washed away into natural steps, of a level and then a small slope of 45°. A breakwater had been formed off that beach, by throwing in loose masses of rock forming their own slope; this, when carried up to within ten feet of the water-level, stood well.

In Nootka Sound, the same effect of the drawback of the waves was noticed. Sections of the Mole of Venice were shown. That mole, which is nearly 16 miles in extent, had a section of a sloped foreshore with a nearly vertical wall, then a slope at another angle, and above high water mark another nearly vertical wall. When the

seas rolled in upon the mole, they partially curled over against the first wall, and were projected with augmented force against the upper one. The consequence was, that the mole was partially destroyed. and in the repairs, which had been executing for some time, it had been reduced to one uniform sloped face, at an angle of about 15°. The destruction of the nearly vertical walls of Portpatrick was also noticed. Those walls, although constructed of the finest Anglesea limestone, well dressed, dove-tailed, and tied down vertically and horizontally by iron chain-bonds, were completely overthrown; and, until the thickness of the wall was increased to 80 feet of solid material, it could not be made to stand. The situation was extremely exposed, and the sea frequently sprung 50 feet above the top of the light-house, which was itself 60 feet above the level of high water of spring tides. The causes of the peculiar action of the draw-back of the waves, as exemplified by the removed shingle from the beach when the wind was on shore, and its accumulation when the wind blew off the shore, were also discussed; and it appeared to be the received opinion that, in these cases, the upper part of the waves being acted upon by the wind, a peculiar rolling motion in a counter direction was imparted to the lower wave, which acted upon the shingle in the manner alluded to. This action appeared, however, only to extend to a depth of about nine feet, which, it seemed to be agreed, was the ultimate depth of detrimental action of all waves. The forts of Boulogne were given as further examples of the reflection of waves from nearly vertical walls; but it was shown that the darting over of the waves there, was caused by their falling within the re-entrant angles of the fortification.

The effect of advanced groynes in protecting sea-walls was exemplified by the concrete walls at Brighton and Dover, which were extended merely for retaining walls; and such was the effect of the groynes, that, since they had been put down, the shingle had accumulated to such an extent, that the sea did not approach injuriously to within 100 feet of the base. Our limits will not permit a greater detail of this interesting discussion, which will, however, appear entire in the proceedings of the Institution. Civ. Eng. & Arch. Jour.

On the practical forms of Engineering Works exposed to the action of the Waves of the Sea, and on the advantages and disadvantages of certain forms of construction for Breakwaters and Sea Walls.

By Mr. John Scott Russell.

[Read at the Institute of Civil Engineers, March 9th, 1847.]

Although agreeing, as a general proposition, with the truth of the observation, that it was impossible to lay down any one undeviating rule for a form of sea wall which should suit all cases,—the author had, from long and careful experiment, and examination of various localities, endeavored to classify certain forms of artificial constructions, and to adapt them to certain cases, having reference in each case to

the action of the waves to which they were to be exposed. His first process was to examine the action and character of the several kinds of waves, deducing, as a given axiom, that,—First, The common form of waves is cycloidal. Second, The motion of the waves in a disturbed state is circular, and in a vertical plane. Third, The water near the top of a wave moves the same way as the wave itself. Fourth, The water in the hollow between the waves is receding. Fifth, The power of a wave is exactly in proportion to the height of its crest above the hollow between the waves. Sixth, The greatest power a wave can exert is at the moment of the crest breaking over into the hollow. Seventh, Waves in the British seas have rarely been seen of a greater height than 27 feet above the hollow, and 32 feet may be taken as their greatest unbroken height; those of the Atlantic being stated to range higher. Eighth, Waves have never been seen of the full depth of the water forming them, hence it is deduced that the greatest force waves can be exposed to, may be determined by the depth of the water they are placed in. Ninth, There are two or more classes of waves,—wind-waves, short, high, and superficial; and storm-waves, which are long, low, and deep. Tenth, The depth of agitation caused by a wave is in the ratio of its height and length conjointly. Reasoning upon these data, the paper then proceeds to examine two classes of hydraulic works. First, Those which are designed to act upon the waves; and, Second, Those whose structures are exposed to the sea without any design of controlling it, but only to guide it under particular circumstances.

Of the first class are sea walls, piers, and other sea defences intended to restrain the action of the waves; for the forms of which a number of designs were given, ranging between the flat slope, with a foreshore, and the vertical wall. Of all these, the preference was given to a wall having a concave or cycloidal curved face, to carry the wave up without breaking; overhanging coping curved on the underside to return the wave upon itself, and a recessed parapet on the outside to prevent the wave from being thrown inside. For breakwaters, whose object was to resist the waves and produce still water within side, the best mode, under all circumstances of locality, variety of materials, and cost, appeared to be the depositing of the large and small materials, and allowing them to find their natural slope under the action of the waves.

Of the second class, are works designed to direct the scour at low water, but which are quite covered at high water, the foundations of light-houses, &c., the object being to oppose the least possible resistance to the waves, and to suffer the least from them. Groynes, embankments, and other works intended to be under high water, also coming under this class; the best form is the parabola, with the foot curved outwards on each side—the apex being raised or lowered, and the base proportioned to its application. This form being extended upward, approximates to that of the Eddystone, Bell-rock, and Skerryvore light-houses, which have withstood the action of heavy seas so successfully.

The vertical wall was condemned for many satisfactory reasons:

the cost of workmanship, the expensive character of the materials, the liability to destruction if a breach be made, and the unsatisfactory action, in consequence of the waves making a clear breach over them in heavy weather.

In the discussion that ensued, many interesting illustrations were given of the truth of these positions, derived from the works of Whitehaven, those on the South Devon Coast, and those at Hartlepool, in which latter case the strong red marl, dry punned, and mingled with small stone, and faced with pitching, had been satisfactorily employed, at a very small cost, for the construction of piers. Ibid.

The Isthmus of Tehuantepec.

Extract of a letter from the Vice President of the United States, addressed to a gentleman of the city of Philadelphia, and published in the "Spirit of the Times" of that city.

To abridge the tedious and dangerous voyage around Cape Horn, and to give to navigation a direct and safe access to the eastern shores of the Pacific, has been a favorite scheme for centuries of scientific exploration and of mercantile hope. For a long time its practicability at any point was disputed. The best inquiries left it in doubt. Every narrow portion of the continent of America has undergone examination; has, for a while, been regarded with preference, and has again been abandoned. Difficulties sprang up as to each, and a comparison of their relative advantages, affected more or less by the desire of the respective engineers and explorers to render the junction of the two seas specially serviceable to their own countries, excited apprehensions as to all. Still I am abundantly satisfied that the project is not only practicable, but practicable under the joint auspices of the United States and Mexico, at a moderate cost, and within a short time.

Five routes for crossing have attracted special notice. 1. By the isthmus of Panama. 2. By the isthmus of Darien. 3. By the lake of Nicaragua. 4. By the river Atrato, from the gulf of Darien, running south through Choco, in New Grenada, until it nearly meets the San Juan, which empties itself into the Pacific at the port of Charambiro. And 5. By the isthmus of Tehuantepec. Of these routes it may in general be said that the one across the isthmus of Panama and the one by the lake of Nicaragua have been heretofore best explored and most approved. In 1805, Baron Humboldt, who enumerated four additional routes, was discouraged as to that by Panama, because "*no measure of elevation, and no level, had ever yet been executed in that isthmus;*" and from all the information he could procure, it appeared to him that the expectation of a ship channel by canal across that isthmus "*ought to be completely abandoned.*" Since that period, however, the topography of the region has been carefully and closely investigated. Steam power and railways have become adjunctive elements for calculation and arrangement, and conclusions much more favorable, as well as better founded, may now be drawn. In 1825, a

well-reasoned but still imperfect judgment in favor of the Panama route was published, and several others have since appeared; but the last, and far the most impressive, is in a Parisian pamphlet purporting to be an abstract of a report made to M. Guizot, the Minister of Foreign Affairs, by Napoleon Garreli, engineer in chief, attached to the Royal Mining Corps in 1845, and to set out a "Project for uniting the Atlantic and Pacific Oceans by a Canal across the Isthmus of Panama." In 1829, G. A. Thompson, a diplomatic agent of the British Government, published his "Official Visit to Guatemala;" and he therein describes the route by the lake of Nicaragua, and the various steps which had been taken (in 1825) as well by the king of the Netherlands as by great banking houses in England, with the legislative sanction and aid of the local government, to form a navigable communication between the two oceans by means of that lake and the river San Juan. This mode of effecting the object has commended itself, after critical scrutiny, to many others, and seems to be somewhat favored by P. Campbell Scarlett, a British traveler, in his lively work on "South America and the Pacific," printed in 1838.

You cannot, however, be benefited by my considering further or minutely the facilities or difficulties of the Panama and Nicaragua routes. Whatever may be the superiority of their advantages, we are not in such a relation to them as can make it of the slightest practical use to enter elaborately into their development. Let me fix your attention exclusively on the route by the isthmus of Tehuantepec—a route which, if practicable on almost any terms, must recommend itself over all others, by being, as it were, at the very outlets of our estuaries, or on our commercial threshold.

This route runs through Mexican territory. It commences at the mouth of a river called the Huasacualco, emptying itself into the southern section of the Gulf of Mexico: it thence takes a generally southern and western direction until it reaches Tarifa, at which town a canal or rail-road begins; and the route with it continues in the same course to western lakes, which then furnish a direct highway to the river, the city, and the gulf of Tehuantepec on the Pacific. The topography of this isthmus has been investigated with some care; it might, indeed, be unwise to begin practical operations without a fresh and thorough survey, but enough is known to render it quite certain that the communication can be opened without unreasonable expenditure of labor or money.

The width of the isthmus, from the mouth of the Huasacualco on the Mexican gulf to the shores of the Pacific at Tehuantepec, is about one hundred and thirty-five miles. The central mountainous chain, which, conformably to its relative position throughout both Americas, is much nearer to the Pacific than to the Atlantic ocean, exhibits here a depression which continues from Santa Maria Patapa to Miguel de Chimalapa. For a distance of about twenty-five miles, a summit-level or plain is formed, whose streams flow north, and whose boundaries at the south and south-east are a chain of small hills called the Cerros (highlands) of Masalma and of Espinosa, which separate the waters flowing north from those flowing south, and between which, here and

there, are passages, such as the Portillo (gate) of Chivola, and the Portillo of Tarifa. Streams, starting from this space of depression in the great mountainous ridge, and running *north*, empty themselves in the Huasacualco; those running *south* empty themselves in the Chicapa, which, in turn, discharges itself into the lakes east of Tehuantepec; and it is one or both of these rivers—Huasacualco and Chicapa—which may be employed in effecting the transit across the isthmus, by uniting them either by a canal, a railway, or a good macadamized road.

This route for the junction was pointed out by Fernando Cortez, the conqueror, as long ago as the year 1520. Indeed all the three principal routes to which we have referred—Panama, Nicaragua, and Tehuantepec—were designated by Lopez de Gomarra in his History of the Indies, as early as A. D. 1551; and it is worthy of remark, that these three routes are the only ones which, after the lapse of three centuries and many explorations, present the least promise for the construction of a ship canal.

For more than two centuries the hope of effecting a navigable communication between the oceans seems to have been wholly abandoned. At the close of the last century, however, this old project of uniting the Huasacualco with Tehuantepec, in Mexico, revived; and Augustin Cramer, after making some researches in 1774, under the orders of Viceroy Bucareli, proposed to carry it into effect by a canal, fed from two small tributaries of the Huasacualco. More recently, the general government of Mexico, in 1825, authorized General Orbegozo to explore this route; but that officer, misled by the defect of the only barometer he had with him, came to the conclusion that the construction of a canal there was a work almost impracticable, and restricted himself to recommending a good road. At last, in 1842, Joseph de Garay, having obtained, by legislative desire, the privilege of making a communication between the two oceans across this isthmus, established a board of commissioners under the direction of an engineer, Gayetano Moro, with instructions to give the isthmus a thorough scientific exploration. Moro published his labors and their results in 1844; and, as the information he gives is certainly the latest and most authentic, it may be agreeable to you to have it set forth briefly.

The village of Tarifa, which gives its name to the plain at the depression of the central chain of mountains to which we have referred, is seated about 700 feet above the level of the sea; the plain itself is somewhat lower. The hills which bound the plain on the south and southeast, and divide it from the waters flowing south, have but little elevation; and a cut of some fifty or a hundred yards in length would alone be sufficient to enable some of the streams on the plain to run south by the Portillo of Tarifa. One of these hills, the Del Convento, in which the Rio Monetza takes its rise, and thence flows into the Chicapa at San Miguel, stands alone, and on two of its sides, particularly at the north, are clefts so sunken that a cut through them would be a work of extreme ease. The direct distance between Tarifa and the river Bocabarra, through which the lakes on the western side of the isthmus reach the Pacific, is about thirty-seven miles. On

the southern declivity, the principal streams are the Rio Ostuta and the Rio Chicapa, both of which empty themselves into the lakes, the latter about eighteen miles from the Bocabarra and nineteen miles from Tarifa. All the streams on the northern declivity flow into the Huasacualco, and that river, after a very winding course, reaches the Gulf of Mexico, about one hundred and five miles from Tarifa. One of its chief tributaries is the Malatengo, which flows into it on its left bank, about ninety direct miles from its mouth, or one hundred and sixty miles following its circuitous bed. The Chicapa, gauged above San Miguel Chimalapa, by combining several rivulets flowing from the central chain, rolls a body of water estimated at about twenty-two cubic feet per second. The Ostuta is in volume five or six times larger, and, which is really remarkable, and indicates extreme thirstiness of soil, this volume of water diminishes as it lengthens its distance from its original source.

The volume of water in the Huasacualco is great, and at the lower part of its course it would be navigable for ships of any size, were it not for the bar at its mouth. The depth of water upon this bar has been, at different times, ascertained to be: by Dampier, fourteen feet; by Cramer, eighteen feet; by Orbegozo, fourteen feet; by Robinson, twenty feet; by Moro, twenty feet. These differences are explainable, with great probability, by supposing the bar to be intersected by submarine canals, or clefts, and the soundings not to have been made in the same one.

At about thirty-three miles from its mouth, near a place called La Horqueta, (the Fork,) the Huasacualco divides into two branches, the right and chief of which, the Apotzongo, runs a course of twenty-five miles, and the other, or left one, the Mistan, a course of about thirty-three miles—they encircle a large island called Tecamichapa. Below this island, the depth of water always exceeds twenty-two feet, and becomes sometimes thirty-seven or thirty-eight feet. But above the re-union of the two branches, there are shallows, which, it is thought, may be got rid of by damming the Mistan at La Horqueta. Above this latter point, the depth decreases; at some places it is found to be from twenty-five to thirty feet, but in general it is less than twenty-one, and even sinks to seven or four. Two points only, however, may be regarded as difficult to overcome—the old Mal-paso, and the present Mal-paso—the first being between three and four miles below the confluence of the Malatengo with the Huasacualco, and the second between nine and ten miles below the first, at the confluence of the Rio Sarabria. At these two points, the rocky character of the river's bed would make its deepening difficult.

On the other side of the isthmus, the Bocabarra, which constitutes the pathway between the Pacific ocean and the lakes, or lagoons, into which flow the Chicapa and Ostuta, has a depth of about twenty-four feet; but its opening on the lakes is obstructed by a bar, whose depth of water does not exceed nine feet. Moro ascribes the original formation of this bar, in a great degree, to the fact that formerly the river Tehuantepec emptied itself into the lake, and is of opinion that if it

were removed by artificial contrivances the result would be permanent. He thinks that this removal might be accomplished by giving a direction to much of the water of the Ostuta above towards feeding the canal, and thus diminishing the force of the current in the lake. After passing the bar the depth increases; but throughout the eighteen miles, or thereabouts, of distance from the bar to the mouth of the Chicapa, not more than nineteen feet of water are to be had, though modes of augmenting its depth could readily be found.

These minute details, translated and transferred from the French publication already mentioned, and whose accuracy I perceive no reason to doubt, are introduced here in order to show that the subject has not been lightly considered. They prove that the two principal obstacles to the creation of a ship channel across the isthmus are the bars at the respective mouths of the Huasacualco and Bocabarra. Now, the bar at the mouth of the first of these rivers ceases to be an impediment as soon as its main submarine canal, over which twenty feet of water have been found, is fixed with accuracy and marked by lines of buoys; and the bar at the mouth of the other river, within the lake, is removable, either in the manner suggested by Moro, or upon the plan heretofore successfully pursued, under the direction of our corps of topographical engineers, with bars at the entrances of our rivers from the northern lakes. Then, by surmounting the inferior obstacles, —namely, the occasional shallowness of the Huasacualco, and of the lake, either by sinking the bottoms or raising the water, and the short dividing swell of land between the source of the Rio Monetza, running south into the Chicapa, and the source of any one of the streams running north into the Huasacualco—an uninterrupted water highway is effected. There does not, indeed, appear on the whole line of this route any difficulty which the present resources of our science and mechanical art may not vanquish.

We should all, perhaps, prefer a canal of large dimensions, fit to accommodate vessels of every size; and the expenditure for such a one, having reference to the route specially described, is estimated differently at from fifteen to twenty-five millions of dollars. These estimates are liberal, and are probably exaggerated by an imperfect knowledge of the local aids in the presence and cheapness of material and labor which would be furnished. Still, the highest valuation is, in contemplation of the purpose and its incalculable results, far from being appalling. But it may be, that a canal much smaller, and, of course, less costly, would be attended by every substantial advantage; and, indeed, it is even easy to imagine that consequences very salutary and important might flow from leaving inducements to the construction of of two free cities, one on the bank of the Huasacualco, and the other on the bank of the Bocabarra, or the Pacific, as *termini* to a railway. It will appear, from a careful consideration of the commerce which may be expected to direct its course through this passage, that the number of vessels of heavy tonnage and deep draught would bear a small proportion only to those of light tonnage and shallow draught; and, in all probability, the great additional expense incident as well to the construction, as to the keeping up, of a canal on the larger scale,

would not be repaid by corresponding advantages. The average burden of vessels from the United States to the ports on the Pacific, including the Sandwich Islands, to China, and on whaling voyages during the years 1845-'46, was short of 400 tons; and I should doubt whether, if this junction were effected, the burden of nineteen-twentieths of the craft passing through it would exceed that engaged in our coasting navigation. A canal adequate to the perfect accommodation of the great influx from our own country might, therefore, exact an outlay of but ten millions; and trans-shipments of large cargoes, though always more or less inconvenient, could be indemnified by the rapidity of transit by steam power. It is hardly necessary to say that the American people, in the event of a speedy restoration of peace, will find themselves in circumstances of extraordinary prosperity, which will enable them to afford, out of the national treasury, to appropriate for five years five millions of dollars for the superior, or two millions for the inferior, order of canal.

Having given you this sufficiently precise description of the contemplated work, showing it to be practicable, and nothing repulsive in its probable cost, let me indulge in a few remarks of a more general character, or rather hints for you to meditate upon.

The chief objects to be attained are, a speedy communication between this country and the western coasts of North and South America, especially with our Territories of Oregon and California; an easy and quick access to China, the groups of the South Sea Archipelago, the Sandwich Islands, Russian settlements, and even, before long I hope, the tempting and untouched treasures of magnificent Japan; and, finally, the facilitating and enlarging of that great source of wealth, as well as nursery of able seamen, the whale fishery.

Now, I cannot resist the impression that this junction of the two oceans at the isthmus of Tehuantepec would Americanize this vast and augmenting portion of the commerce of the world. It would give to the people of the United States the overwhelming advantage of an abridgment, by fully one-half, of geographical distances. Against the merchants of Europe it would give ours two voyages to one. There is scarcely a region in the limitless South Sea, with which a trade would be lucrative, that could not be reached by them in half the time that would be consumed by English, French, Spanish, Dutch, or Swedish navigators. "If," says Mr. Scarlett, "this scheme were realized, it has been calculated that the navigation from Philadelphia to Nootka Sound and the mouth of the Columbia river, which, by Cape Horn, is now 5000 leagues, would be reduced to 3000 only!" In fact, the reduction would be greater. But at this rate what would the reduction necessarily be as regards the navigation in that direction from New Orleans, Mobile, St. Augustine, Savannah, and our entire southern seaboard? The interchanges of commodities between our great and teeming valley of the West, and the rich and rising regions of the Pacific, would be accomplished almost at the mouth of the Mississippi.

Nor can securing, in this way, for our own country, the just benefits of her relative position be made the subject of complaint by other na-

tions. We do not propose—at least I hope not—to monopolize the uses of the canal; on the contrary, it would be thrown open on terms, if not of equality and freedom, of the utmost liberality. Although an artificial structure, reared by the money and policy of our people, I would give it the unchangeable character of a public highway of nations.

Always sincerely yours, G. M. DALLAS.

AMERICAN PATENTS.

Annual Report of the Commissioner of Patents, for the year 1846.

Sir,—In conformity to the provisions of the Act of Congress relating to this office, approved March 3, 1837, the undersigned has the honor to submit his annual report.

During the year ending December 31, 1846, the whole number of applications for patents received, is twelve hundred and seventy-two. The whole number of caveats filed during the same time is four hundred and forty-eight. The number of patents issued in 1846 is six hundred and nineteen, including thirteen re-issues, five additional improvements, and fifty-nine designs; classified and alphabetical lists of which, with the names of the patentees, are annexed.

During the same period, four hundred and seventy-three patents have expired, a list of which is annexed.

Three applications for extensions were made during the year; two of which were rejected and one is still pending. Two patents have been extended by Congress during the same period.

The claims embraced in the respective patents issued during the year 1846 are annexed.

The receipts of the office during the year 1846, including duties and fees paid in on application for patents, caveats, re-issues, additional improvements, extensions, and for copies, amount, in the whole, to $50,264·16; of which sum, $11,086·99 have been repaid on applications withdrawn, and for money paid in by mistake.

The expenses of the office, during the year 1846, are as follows, viz:—for salaries, $16,142·97; temporary clerks, $5685·61; contingent expenses, including postage and the fees paid to counsel in two suits recently pending against the Commissioner, in the United States District Court for the Eastern District of Pennsylvania, $7485·19; compensation of the District Judge, $100; library, $675·96; agricultural statistics, $3610·68; amounting, in the whole, to the sum of $33,700·41.

There was also expended, during the last year, under the act of March 3, 1837, for the restoration of records and drawings, the sum of $786·31, and for duplicate models, the sum of $585.

The aggregate of expenditures under the different heads above enumerated, including money paid back on withdrawals, and for the restoration of records, drawings, and models, is $46,158·71, leaving a balance, to be carried to the credit of the patent fund, of $4105·45.

On the first day of January, 1845, the amount of money in the treasury to the credit of the patent fund was $182,459·69, which, with

the balance paid in during the year 1846, will, on the first day of January, 1847, amount to $186,565 14.

Although the balance which the office has been able to place to its credit in the treasury during the year just past, in consequence of the decreased amount received on applications for patents, caveats, &c., (there being fewer foreign applications during the last year,) and the additional amount refunded to applicants on the withdrawal of their claims, is not so great as that of the previous year, yet it is more than the average balance of former years, and indicates the flourishing condition and prospects of the Patent Office.

Thus far the office has more than sustained itself, and fully realized the anticipations of Congress when it was re-organized upon its present footing. And if a conclusion may be drawn from the activity of the inventive genius of our countrymen, as exhibited in past years, we may rely confidently in the belief that this useful and noble institution of the government will never become a charge upon the treasury.

The reports of the two principal examiners, giving a very interesting review of the inventions patented at this office during the past year, are annexed.

On reference to them, it will be seen that the year just past has not been without its valuable discoveries, which, if they do not surprise and delight the mind with their novelty and brilliancy, will contribute much to the convenience and welfare of man. It will be seen that almost every field of invention and discovery has been explored by our ingenious, persevering, and indefatigable countrymen, and many very valuable improvements in machinery, and processes of manufacture, brought to light; all contributing more or less to the improvement and progress of society. The operations of this office during the past year prove, as the circle of every year proves, that the inventor is ever the benefactor of his race. His genius bestows its favors on all. The manufacturer, the mechanic, the agriculturist, the merchant—all are recipients of the benefits which flow from his toils, energies, and sometimes his great and sublime conceptions. No theme is more interesting for contemplation than this, and there is none which more deeply impresses the mind with a sense of the continued and onward progress of society in the grand career of civilization.

In my last annual report I embraced the occasion to bring to the notice of Congress the embarrassed condition of this office, in consequence of the great increase of its business, without a corresponding increase of its clerical force, particularly in its scientific department.

When the office was re-organized, in 1836, the Commissioner was allowed but a single examiner. By the 11th section of the act of March 8, 1837, an additional examiner was authorized to be appointed; and by the act of March 3, 1839, two assistant examiners were provided for; since which time no addition to the examining corps has been authorized, and none has been made.

In 1840, the first complete year after the last addition to the examining force was authorized, the number of applications for patents

received was 765, the number of caveats filed 228, and the number of patents granted 475.

During the year 1846, the number of applications for patents was 1272, the number of caveats filed, 448, and the number of patents granted, 619. During the same year, the number of applications for patents which were examined and rejected was 398.

Thus does it appear that, since the last addition to the examining force in 1839, the business of the office has increased nearly one hundred per cent. It has increased beyond the physical ability of the present examiners and assistants to keep up with it, although constantly and industriously engaged in the performance of their onerous and fatiguing duties. The consequence is, that business accumulates upon their desks; applicants are delayed in having their cases examined, often to their great detriment, and always to the injury of the office; which is complained of for its delays by persons not knowing the condition of its business and the inadequacy of its force, when it is constantly exerting itself to the utmost to accommodate the public, as well as to relieve itself from inconvenience resulting from a pressure of its duties.

When it is considered that the Patent Office derives its revenues entirely from the inventors, and sustains itself without charge upon the treasury, the justice of their complaints cannot be denied nor evaded. But I am confident they cannot attach to the Patent Office, nor to any of its officers. The state of its business was fully presented to Congress in my last report, and again in a subsequent communication addressed to the chairman of the Committee on Patents and the Patent Office of the Senate at the last session.

It is therefore respectfully submitted, whether, in view of the fact that its revenues are ample for the increased expenditure, which will in that event be required, it is not expedient for Congress to authorize the addition to the examining corps which the present state of the business of the office imperatively demands.

By the 11th section of the act of March 3, 1837, I am authorized to employ all necessary temporary clerks for writing and copying, at a compensation of ten cents for every hundred words. This provision enables me to provide for any exigency in the clerical department of the office. No addition, therefore, is deemed necessary to this branch of service in the office.

In connexion with the subject of an increase of the scientific force of the Patent Office, I would again respectfully suggest the propriety and expediency of increasing the salaries of the principal and assistant examiners. This subject was brought to the attention of Congress by my predecessor in his last annual report, and its expediency and justice portrayed with great force as well as earnestness. Convinced, from my own observation, of the justice of his recommendation, I cordially concurred with him in the views which he expressed, and enforced the recommendation with such additional reasons as my own experience had placed at my command.

Deeming it unnecessary to repeat the reasons in favor of the proposition, which I again submit, I would respectfully refer to the last re-

port of my predecessor previous to his retiring from this office, and to my own of the last year, for all the information which is deemed necessary to enable Congress to come to a correct conclusion in relation to the subject.

But I would again refer to the able and interesting reports of the examiners attached to the reports of the Commissioner for the last two years, and to this report, for proof of the talents and scientific qualifications requisite to enable the incumbents to fill those laborious and responsible desks with credit to themselves and usefulness to the country. The remark may be safely hazarded, that there are but very few offices in the government which require more ability for sound and nice discrimination, more extensive and varied acquirements, and, it may be added, more inflexible integrity of character, than the office of examiner of patents.

The revenues of the Patent Office are ample for the proposed increase of force and salaries in the examining corps; and the interests of the public, as well as of the inventors, require that it should be made.

In my last annual report I had the honor to submit to Congress a proposition for certain modifications of the existing patent law, which I deemed important and necessary for the protection of the inventor as well as the public. A bill, embodying most of the modifications suggested, was reported in each House by the committees having the matter in charge; but in consequence of the great amount of business pressing upon Congress at the last session, it failed to become a law.

The bill provided for two important and essential changes in the existing law in relation to patents. One of those provisions was, that in all suits brought by the patentee for infringements of his invention, the letters patent securing his invention should be received by the courts trying the same as conclusive evidence of his right to recover damages, until they were set aside by the institution and prosecution to final judgment of a process for their repeal. The other was a provision for the institution of a process for the repeal of letters patent which had been obtained by fraud, misrepresentation, or upon false suggestion, or which were void, in whole or in part, for want of novelty, or other cause. The very inadequate protection afforded to the patentee by the present law, seems to me to furnish sufficient reason for the proposed modification.

After the rigorous and searching ordeal through which every invention passes at the Patent Office, it certainly seems reasonable that the letters patent, under the seal of one of the offices of the government of the United States, should be received in courts of justice as conclusive evidence of the title of the patentee to his invention, and his right to recover, until his patent shall have been revoked and annulled for good and sufficient cause, by a tribunal competent to investigate the matter.

But the present law extends no such protection to the patentee. At present his letters patent are only *presumptive* evidence of the novelty of his invention, and of his right to recover. Consequently, the validity of his patent may be, and for the purposes of embarrass-

ment often is, put in issue in suits for infringement, and he is compelled to prove the novelty of his invention over and over again, as often as the depredator upon his rights, whom he seeks to punish, is disposed to put him to that trouble.

Many instances of this wanton aggression upon the rights of the meritorious inventor have come to the knowledge of the undersigned since he has had the honor to be at the head of the Patent Office. And many of these instances of aggression proceed from wealthy and powerful companies and corporations, and the subjects of them are the inventors of the most useful and valuable machines and improvements. The more valuable the invention, the more liable is it to piracy and infringement. These wealthy and powerful bodies know well the benefit to them of the law's delay, and its ruinous expense to the single handed individual who dares to resist their unlawful and unjust invasion of his rights; and hence, in the end they hope to win, either by the defeat of the patentee by means of some trifling defect in his title deed, or his inability to procure the necessary evidence to substantiate his right, or by a compromise, in which he will be forced to sacrifice a portion of his claims in order to relieve himself from the embarrassment and expense of the unequal contest.

As the law now stands, the great burden of the controversy falls upon the patentee, and not upon the wanton violator of his rights, as it should.

In this view of the matter, I think all candid men will agree that when a patentee has established, in the judgment of the office or tribunal whose duty it is to pass upon his claims in the first instance, a right to letters patent of the United States, that document should be his shield and protection until it is shown by others, who dispute his title, that he has no right to it.

I am aware that there is a prejudice existing in the minds of a portion of the community (small I believe it is) against the claims of inventors. It is contended by some that patents securing exclusive rights to the discoverers of new machines, or processes of manufactures are monopolies, operating to the detriment of the best interests of the community, and existing against the true policy of all just governments; and, therefore, are to be regarded with suspicion, construed with great strictness, and defeated if possible.

I am fully persuaded that, on a little reflection, such a view of the rights of inventors will disappear from the minds of candid and reasonable men. What are the grounds on which all civilized and enlightened governments grant to persons making valuable discoveries in the arts and manufactures a limited monopoly of the benefits of their inventions? The main ground is to encourage discovery and invention—those great agents of social improvement—by securing to those who make them the profits which result from them, in order to enable them to remunerate themselves for their toils and expenditures, and to induce others to explore the vast and limitless field of invention.

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Every new discovery in science and art contributes to the wealth, convenience, and comfort of individuals, and to the improvement of

society. Some of the inventions of the last few centuries have burst upon the world with the brilliancy of the morning sun, changing the whole aspect of society, and conferring incalculable benefits upon the human race. I need mention only the art of printing, the discovery of gunpowder, the steam engine, the cotton gin, the spinning jenny, the power loom, the steamboat, the railroad, and the magnetic telegraph. These great discoveries in science and art have revolutionized the condition of the civilized world, and their influence at this moment is probably more potent and more sensibly felt than ever before.

I mention these great discoveries as striking instances of the effect of the labors of the inventors upon society and civilization. There are others, of less note, producing their due influence upon the condition and welfare of the world. Even the most humble discovery contributes its due proportion to relieve the human family of its burdens, and administer to its comforts, and to accelerate and aggrandize its unceasing and triumphant progress in the improvement of its condition, and the expansion and perfection of its lofty nature and destiny.

Therefore, there is ample reason why society should reward and encourage that class of its benefactors whose claims I am now considering, by securing to them, for a limited term, the exclusive enjoyment of the fruits of their genius and labors.

But it cannot be denied that, upon the principles of abstract justice, the inventor has a complete and unquestionable claim to the fruits of his discoveries until his labors and sacrifices are adequately remunerated.

Many valuable and profitable discoveries in the arts are the result of a sudden and lucky conception in a happy moment; but most of them are the fruits of days and years of incessant toil, anxious and harassing thought, and great pecuniary sacrifices. This toil, this mental effort, and these pecuniary sacrifices, establish a title to the product which is their offspring, as sacred and irrefragable in the eye of justice as the title to his farm, his workshop, or his merchandize, which a man has acquired by his labor, skill, and economy. So clear and convincing is this view of the right of the inventor to the fruits of his genius and labor, that argument in its support would seem to take from its strength. Yet the reasons are equally strong that the inventor's exclusive enjoyment of his discoveries should not be perpetual, but should be permitted only for a limited period.

All inventions, great and small, generally have their period of birth, growth, maturity, and perfection, if the latter term be allowable. And if one mind conceives and gives birth to the first idea, many assist in its development and expansion. Probably no piece of mechanism was ever made which was perfect in all its parts at its first creation. The steam engine is an interesting and beautiful illustration of the gradual progress of an invention, from its first conception in the mind of the inventor to its present wonderful state of perfection and efficiency. It first appeared in a rude form, unwieldy and dangerous to those who dared to operate it—a thing designed more for experiment

than utility; and now, after passing through nearly two centuries of improvement, and taxing the highest intellectual energies of thousands of ingenious and skilful men, it appears to us with a perfection, in the nice and delicate adjustment of its machinery, which astonishes and delights us, and an efficiency and power of action which enable it to confer the greatest and most lasting benefits upon mankind.

The history of this wonderful engine and instrument of civilization shows as clearly and conclusively that the claims of the inventor to the fruits of his genius should not be perpetual, as it does that he should be permitted to enjoy them until he is adequately remunerated for his labor and expenditures. For, if his right to his invention were perpetual and exclusive, no other person could improve it, because he could not use his improvement with the original invention, and therefore not at all. This would immeasurably retard, if not wholly prevent, all improvement of original inventions, and would result in incalculable injury and mischief to society.

Hence, while admitting the unquestionable justice of the claim of the inventor to the fruits of his genius for a period of time sufficient to enable him to remunerate himself adequately for his toils and expenses, it is absolutely necessary, for the progress of improvement and the welfare of society, that his exclusive right should then cease, and his invention become the common property of the public. Others will then have an opportunity to remedy the defects of, and to improve and perfect, his original creations.

And, in accordance with this view of the subject, the constitution of the United States authorizes Congress to enact laws for the promotion of the useful arts, and the protection of the inventor in the enjoyment of the fruits of his genius and skill for a certain period, the duration of which is limited to fourteen years; at the end of which time, in consideration of such protection, his invention, and the secret of it, shall become the property of the public.

I have been thus particular in setting forth the general principles of the patent law, because, as before remarked, a prejudice prevails to some extent in the community against the justice of the claims of the inventor to temporary protection in the enjoyment of the fruits of his labors. I am, however, happy to see that juster sentiments are growing more prevalent in relation to the rights of that valuable and meritorious class of citizens. During the past year, courts of justice have displayed a more earnest desire to give protection to the inventor, as evinced by the liberal construction which they have given to the present imperfect patent law, whenever questions relating to patents have come before them for adjudication.

The bills reported by the respective committees of the two houses contained other provisions less important than the two which I have been considering, deemed, however, to be necessary modifications and improvements of the existing law in relation to patents; but, as they were particularly explained in my former report, it is unnecessary further to consider them.

In connexion with the subject of the amendment of the existing patent law, I would respectfully suggest the expediency of making

some new provision in reference to the applications of the citizens and subjects of other countries for letters patent in the United States.

By the existing law, a subject of Great Britain is required to pay into the treasury a duty of $500 before his application can be examined. The citizens and subjects of all other foreign countries, are each required to pay into the treasury a duty of $300 on their respective applications. These duties were designed to bear some proportion to the duties required of American citizens making applications for patents in other countries, and on that ground may, perhaps, be justified and defended.

The effect of this provision is unquestionably to prevent the introduction into this country of many useful and valuable discoveries, which would otherwise be patented and introduced. Similar high duties have the effect to exclude American inventions from other countries. Thus all countries are injured by this system of taxing genius for the exertion of its powers, in order to obtain comparatively a very small and trifling amount of revenue.

It affords no protection to the American inventor to keep out the discoveries of his foreign emulator (not rival) in the arts, by taxing the emanations of his genius with high duties, while the country would derive much benefit from their introduction.

Therefore, it is respectfully submitted whether it would not be expedient, if Congress should make the amendments to the patent law already proposed, also to provide contingently for the reduction of the duties required on application for patents by the citizens or subjects of foreign governments to thirty dollars, whenever it shall appear that corresponding reductions have been made, by those governments, of the duties required of American citizens. I have reason to believe that the proposition would be received with favor by some, if not all, of the European governments.

As constant inquiry is made, by citizens residing in all parts of the Union, for information in relation to the laws of foreign governments respecting the granting of patents, I have, for the accommodation and convenience of such persons, caused abstracts to be made of the legislative provisions and ordinances of all foreign governments of which this office is in possession, which are hereto annexed.

The law providing for the admission of Texas into the Union failed to make provision for the transfer to this office of the records, models, and drawings of the patent office of Texas. Nor has there yet been made by Congress any provision by which patents granted in Texas, before the admission of that state into the Union, shall be valid in the United States. Under the new relations of that State to the Union, it would appear to be necessary for the public convenience, and the protection of those citizens of Texas who obtained patents under the government of that State when existing as an independent republic, that the contents of the patent office of Texas should be transferred to this office, and that such legal provision should be made by Congress as may appear to be necessary to secure the validity of all patents granted under the authority of that State prior to its annexation to this republic.

Congress, at its last session, having declined to make the usual appropriation for the annual agricultural report made by this office, I regarded the act as an instruction to me not to prepare a report of that character for the year just past, and accordingly none has been prepared, and none will, of course, be made to Congress at its present session.

Whether or not such a report as this office has been required to make for some years past upon the state of the crops, the amount of agricultural products, and the discoveries and improvements in the science and practice of agriculture, is of any value to Congress or to the country, it is not for the undersigned to affirm.

Yet it is respectfully submitted that from no other source could so much accurate and valuable information in relation to the condition and progress of agriculture be obtained, as from the reports of this office upon that subject; of course, not referring to the report of last year.

The remark, I am confident, may be safely hazarded, that from no other source could such accurate estimates of the amount of agricultural production of each year be obtained as from the reports of this office; as the statement of a few facts, showing the ground on which those estimates were made, will clearly prove.

In the first place the office assumed the returns of the census of 1840 as the basis of its estimates. It then observed the progress of the growth of each crop in each succeeding year in every district and county in the Union, from the planting of the seed until the harvest of the matured crop; carefully noting, day by day, and week by week, all the causes which operated favorably or unfavorably upon it; the effect of the weather, the ravages of insects, the effects of blight and mildew, and decreased or additional cultivation.

This extended system of observation it was enabled to adopt through the aid of agricultural and other newspapers and journals, and of letters from distinguished practical agriculturists, received from every neighborhood in our widely extended country. To show the extent of this system of operation, it is only necessary to state the fact that the great number of five thousand newspapers, journals, and letters were carefully read and examined in making up the report for the last year.

It may, therefore, be safely assumed that no institution or association of individuals in the country, had such extensive means at command for estimating the amount of agricultural products within the Union, as were in the possession of the Patent Office.

Of course, it is not intended that the estimates of this office were mathematically precise and exact, for, in relation to such subjects, precision and exactness are absolutely impossible. It is only assumed for them that they approximated as near to precision and exactness as the nature of the subject rendered it possible to approach to certainty. But their general accuracy and value are sufficiently proved by the fact that they were received in this and foreign countries as the best and most reliable estimates of the amount of the agricultural products of this country that could be obtained from any source. And they

are cited and referred to in public documents, and in the leading journals of trade and commerce, as the only authentic estimates of the crops of the United States worthy of reference and confidence.

Assuming the general accuracy of those estimates, it is hardly necessary to speak of their value. The time has gone by when legislation for great communities is to be based upon theories or abstract axioms in political philosophy. Facts, now, are deemed the only solid foundation for the superstructure of the modern statesman. And without a knowledge of the statistics of a nation, which embrace every fact relating to its condition and welfare, physical, moral, or political, it is almost impossible to legislate wisely for its interests. And no statistical knowledge is more important than that which exhibits the resources of a nation, as indicated by the products of its labor. An important part of that knowledge the agricultural estimates of the Patent Office were designed to furnish. Another object of the agricultural report of the Patent Office was to collect and embody every fact within its reach, which tended to show the improvement and progress of agriculture in the United States during each year; and, in order to accomplish this result, so desirable and so valuable to the agriculturist, every new discovery in the science of agriculture, and those kindred and auxiliary sciences from which it derives its most essential aid—namely, geology, chemistry, and botany—and every new improvement and experiment in the practice of agriculture, in this and all foreign countries, were carefully noted, collected, and embodied in a form which enabled every intelligent citizen to see and comprehend the progress of that greatest and noblest occupation of man during the year. In order to perform this portion of its duties, this office was amply provided with the ablest and most approved publications of this country, England, Scotland, France, Germany, and Prussia, not only relating directly to the science of agriculture, but to all branches of science with which it had immediate or remote connexion. It also availed itself of the labors of eminent experimenters in our own country, who kindly and generously communicated to the head of the office the results of their labors and experiments.

All this mass of valuable information collected from a thousand different sources was embodied and presented in a comparatively narrow compass to the American agriculturist, and at a comparatively small expense to the treasury.

I think it may be safely affirmed that in no other country in the world was so large an amount of valuable information collected and presented to the people at so little expense, the annual appropriation to this office for the purpose not exceeding $3,000 per annum. In proof of this remark I would refer to a single fact. The importance of the potato crop—the annual value of which is equal to one-half the value of the whole cotton crop of the Union—which has, during the last three years, been greatly injured by the ravages of that remarkable and fatal disease which has assailed the potato in the northern and middle States, and in most of the countries of Europe, rendered it, in my judgment, expedient to collect and embody every fact which would tend to throw light upon the origin and progress of the disease, and

if possible point out the remedy. With that view a large portion of the report of the last year was devoted to that subject, and a large amount of valuable information respecting it collected, and at very little expense. During the same year a commission, composed of eminent scientific gentlemen, was appointed by the British government to proceed to Ireland and investigate the potato disease as it appeared in that island. The expenses of the commission amounted to nearly $90,000; yet the results of the labors of that enlightened committee, which were very valuable, were all embodied in the agricultural report of the Patent Office, with twenty-fold as much more upon the same subject.

The alarming nature of the calamity which had befallen the potato attracted the attention of many of the governments of Europe, but from none emanated publications containing so large an amount of valuable information upon the subject as the report from this office. The industry of this office, in collecting information in reference to this subject, enabled it to answer the inquiries of many of the governments of Europe.

It is unnecessary to refer to other subjects connected with agriculture which were embraced in the reports of this office. It is believed that the value of the services of this office in relation to the interests of agriculture are appreciated by that great and intelligent class of the people engaged in agricultural pursuits, as would seem to appear from the expressions of numerous letters and public journals received at this office.

If Congress had deemed it expedient to continue the report, several valuable improvements and additions to it were contemplated. A larger field of inquiry had been marked out than had been previously investigated. It was designed to embrace within the scope of future investigation additional crops and products, the amount of cultivated land in the Union, the statistics of the movements of agricultural products from the interior to the commercial marts and their export to foreign countries, the prices of agricultural products, the wages of labor, &c., &c; which, connected with the information previously furnished in a more condensed form, would not have failed to add to and increase the value of the report.

I am aware that it has been objected against the agricultural report of the Patent Office, that it was unauthorized by the constitution, and that, if permitted to be continued, it would endanger the liberties of the people.

If collecting and laying before the country valuable and statistical information is unconstitutional, I have no argument with which to meet the objection; and I am equally unable to comprehend how the operations of this office, connected with agriculture, can endanger the government or the people. It has not its thousand agents scattered through the country, to impress its influence unduly upon the public mind; it has but little money to expend, and no patronage to bestow; its operations are silent and unseen, and they are as harmless as they are silent. Its whole expenditure in this branch of its duties amounts to but a few hundred dollars, and most of that small amount goes in

payment of clerks, the purchase of seeds, and in subscriptions to agricultural publications: but these objections require no further answer.

Nor should it be forgotten that the Patent Office has been instrumental, within the last few years, in introducing into the country many varieties of grains and vegetables; and it has aided much in introducing into the newly settled portions of the Union valuable varieties of grains and vegetables well known in those portions of the Union which have been longer settled, and are more highly cultivated; and, although the popular names of the varieties of seeds it has distributed have given occasion for ingenious irony and dignified ridicule, from sources evidently but little acquainted with such humble yet important matters, no seeds have received names at this office for the purpose of imposition or deception, and none have been distributed which have borne names not familiarly known to every intelligent farmer and horticulturist in the country.

All the varieties of grains and vegetable seeds distributed from this office may not have been valuable. Many, from want of adaptation to soil or climate, may not have been successful—perhaps not germinated; but, if one valuable variety of either is introduced from abroad, or disseminated in parts of the Union in which it was not before known, the trifling cost of the operation is a million times repaid, and the cause of agriculture is promoted.

It has also been objected that the agricultural duties of this office have been assumed without authority of law, and were therefore a grave abuse and usurpation of power. It is not proper, perhaps, for me to vindicate the conduct of my predecessor under whose administration of the office it was introduced. It will not, however, be irrelevant to remark, that the subject had been a matter of serious consideration by the committee of the House of Representatives upon the Patent Office during the session of 1839—'40, and the Commissioner was then requested, by the able chairman of that committee, to communicate to the committee "any information relative to the collection and distribution of seeds and plants; also, the practicability of obtaining agricultural statistics, with the addition of any suggestions deemed important in relation to those subjects."

That inquiry was answered by the Commisssioner in the liberal and enlightened spirit in which it was made, and the collection of agricultural statistics and the distribution of seeds and plants by the Patent Office were santioned and provided for by Congress, by small appropriations made each year, with one or two exceptions, since.

That a department or bureau of government should devote a portion of its duties to the important interests of agriculture, is no new thing in the history of nations. Most, if not all of the leading governments of Europe, have departments charged with these responsible duties, under the supervision of officers called Ministers of the Interior. And such a department seems to have been contemplated by President Washington and the earlier statesmen of the republic.

In the message of General Washington to Congress, in December, 1796, an agricultural or home department is recommended by that

revered and illustrious statesman and patriot. In 1812, it was again recommended in a most able and enlightened report, drawn up and presented to the House of Representatives by the Hon. Adam Seybert, chairman of the select committee appointed to inquire into the state of the Patent Office. And again, in 1817, the subject was considered by a select committee of the House of Representatives, which, through one of its members, the Hon. M. Hulbert, reported in favor of the establishment by Congress of a National Board of Agriculture.

The views of the committee were expressed in the following brief and emphatic language: "The extent of territory, and the richness and consequent productiveness of the soil of our country, can never fail to invite and employ in the cultivation of the earth far the greater portion of American industry.

"The interests of agriculture must therefore be primarily important to the people of the United States, and must at all times deserve the warm support and liberal patronage of government. The committee observe, with pleasure, that President Washington, in his speech to Congress of the 7th of December, 1796, recommended to that body the interests of agriculture, and the establishment of a national board to promote the same.

"In different parts of Europe, as well as in several States of this Union, such boards have been instituted under the auspices of government, and have diffused much useful information, and contributed largely, as the committee believe, to the public welfare.

"After due consideration of the subject, the committee are of the opinion that it is advisable to establish at the seat of government a national board of agriculture, and report a bill for that purpose."

It is not recommended, nor is it desired by the undersigned, that any such department, or national board of agriculture, should be instituted by this government. The practices of other enlightened governments are referred to only to show that the exercise of such functions by government is not without precedent, nor without utility.

The concurring testimony of a very large number of intelligent citizens from every State and district in the Union, received at this office, furnishes convincing proof of the beneficial influences of the agricultural reports of the Patent Office. They have been distributed, through the agency of Congress, to every district in the Union; they have penetrated every neighborhood, and been read in almost every family; and they have awakened an interest upon the subject of agriculture among the intelligent farming classes of our population not before exhibited nor felt. If they have not always led to efforts to improve, they have produced in the mind even of the humbler agriculturist a conviction of the true dignity of his noble avocation, and of its first and transcendant importance among the great interests of his country. If they had produced no other effect, the money which they have cost would not have been idly expended.

Nor should it be forgotten that it is the only expenditure which has been made by Congress for the especial benefit of the agricultural classes; the only expenditure for an interest in the pursuits of which ten-fold the amount of capital is invested that is invested in any other

pursuit; many times the amount of value annually produced that is produced by any other interest; and many times the number of persons employed that are employed in all the other great interests of the country put together. Yet how much is expended, and how much time is employed, in legislating for those other interests, and how little for agriculture!

All which is respectfully submitted,

EDMUND BURKE,
Commissioner of Patents.

Patent Office, Jan., 1847.

List of American Patents which Expired in 1846.

Acid, Vegetable	N. S. Allison & B. Kugler, Philada., Pa., June 5.
Alarm bell for time-pieces,	Robert Wilson, Williamsport, Pa., July 3.
Alcohol for stiffening hats,	William McCay, Northumberland, Pa., June 22.
Andirons,	William Wilson, Greenfield, Mass., May 16.
Apples, grinding, and shelling corn,	Harris, Newton, Webster & Dart, Truxton, N. J., March 10.
Do. do. do.	Jonathan K. Deane, Augustus, Ohio, April 5.
Awl haft,	David M. Smith, Gilsum, N. H., October 25.
Axes,	Jonathan Pratt, Jr., Charlemont, Mass., April 6.
Do.	Benjamin Smith, Canton, Conn., Nov. 2.
Do. hatchets, &c.,	David Hinman, Winchester, Conn., Nov. 2.
Do. Oval	Asahel Collins, Winstead, Conn., Oct. 25.
Axletrees, friction rollers	Francis Rees, Clarksville, Ga., April 14.
Baker, Reflecting tin	William Prescott, Boston, Mass., May 24.
Do. and roaster, Double reflecting	Samuel Hasey, Rensselaerville, N. Y., Dec. 28.
Balance, Compound lever	Jared B. Whetmore, Rush, N. Y., Feb. 27.
Do. Steelyards	E. & T. Fairbanks, St. Johnsburg, Vt., Sept. 22.
Do. Do. &c.,	Do. do. do. do.
Do. weighing heavy bodies	Do. do. do. Feb. 21.
Bank notes, Preventing counterfeiting	J. Peabody & J. Dixon, Salem, Mass., April 20.
Bark mill,	James T. Gifford, Veteran, N. Y., Feb. 27.
Do. do.	D. Hamberd & G. Downs, McConneltown, Pa. March 27.
Barrels for oil,	Barnabas Springer, Henry county, Ind., April 27.
Bath, Elastic cot	W. C. Palmer, New York, N. Y., Nov. 24.
Do. Applying steam	Boyd Reilly, Philadelphia, Pa., July 31.
Bedbugs, Destroying by steam	Benj. Overman, Greensborough, N. C., June 22,
Beds, Cork for filling	Stephen Bates, Boston, Mass., Dec. 28.
Bedsteads,	Cornelius Van Noy, Lexington, Ky., Jan. 10.
Do.	Bethel Judd, New London, Conn., May 25.
Do.	Henry Reisinger, York, Pa., Aug. 18.
Do. fastenings,	Hardin Branch, city of New York, April 18.
Do. do.	John Richman, Lancaster, Ohio, Dec. 28.
Do. sofas, settees, &c.,	John P. Allen, Manchester, Mass. May 19.
Beer or ale, Restoring sour	Moses Granger, Lowville, N. Y., Jan. 14.
Do. Making spruce	George Jones, Boston, Mass., Jan. 27.
Bells for cows or sheep,	Samuel Booth, Berlin, Conn., June 1.
Binnacle lights,	William Lawrence, Meriden, Conn., Nov. 14.
Bleaching Bayberry wax	Benjamin Gomperts, city of New York, Feb. 14.
Do. yellow beeswax,	John A. Shultz, city of New York, April 30.
Do. cotton, linen, &c.,	John B. Green, Portsmouth, N. H., May 29.
Boards, Shearing	Simon Willard, Cincinnati, Ohio, May 9.
Do. &c., Seasoning, &c.,	Abraham Plumb, Buffalo, New York, April 6.
Boilers, Steam, Supplying with water	Jesse Fox, Lowell, Mass., March 14.
Books, Cutting	Archibald O. Douglass, Philada., Pa., Jan. 6.

Boots, Crimping	Silas Wetherby, Essex, Vt., May 12.
Do. do.	Lewis Lucas, Barre, Vt., July 25.
Do. &c., Gum elastic soles	Wait Webster, city of New York, May 19.
Do. Pegging machine for	William B. Randall, Fayette, Maine, April 6.
Do. do. do. do.	Frederick Gray, Rowley, Mass., April 6.
Do. Taps for soles	Stillman Knowlton, Athol, Mass., Oct. 25.
Boxes of wood,	Harrison Holland, Belchertown, Mass., April 13.
Brand for flour barrels,	Samuel Huse, Newburyport, Mass., June 28.
Bricks, Moulding	John Drummond, Whitestown, N. Y., March 6.
Do. do. and pressing	Daniel Barnford, Deerfield, N. Y., April 28.
Do. do. do.	David Phillips, Natchez, Miss., June 23.
Do. press,	David M. Crellis, Sandwich, N. H., Aug. 11.
Do. Stock, tile, &c.	D. Flagg, Jr. & A. Parker, Sweden, N. H., Dec. 28.
Brush, broom, &c., handles,	Evans Turk, Harrisburg, Pa., May 18.
Buds, Delaying blossoming	Robert Moore, Rowan county, N. C., March 16.
Buildings, Securing from fire,	Ebenezer Mix, Batavia, N. Y., Nov. 22.
Bungs, Manufacturing	Robert Barlow, Philadelphia, Pa., Dec. 1.
Canal locks, Securing water in	James Dewees, Pottsville, Pa., Dec. 31.
Candles, Dipping	John Aborn, Trenton, N. J., May 19.
Cannon, Primers for percussion	Joshua Shaw, Philadelphia, Pa., Dec. 31.
Car, Railroad	John C. Blauvelt, Rockland county, N. Y., July 11.
Do. do.	Isaac Cooper, Baltimore, Md., Oct. 25.
Do. do.	Samuel Snyder, Lancaster, Pa., Nov. 10.
Carding machine,	Robert Bartlett, Ripley, Ohio, Oct. 25.
Do. do.	Luther Colburn, Fairfield, Vt., Nov. 20.
Cards, boards, &c.,	Homer Whittimore, Newton, N. Y., April 27.
Do. Cotton and wool,	Edward Faber, Pittsburg, Pa., Jan. 24.
Carriages, Disengaging horses	Robert Beale, Washington, D. C., May 12.
Cement for wood, brick, &c.,	Richard Walsh, Boston, Mass., Jan. 5.
Chimneys, Preventing smoking, &c.	Jeremiah Sullivan, Washington, D. C., April 27.
Churn,	John H. Brunwer, McKean, Ohio, Feb. 9.
Do.	Jedediah Darrow, Warren, Ohio, June 2.
Do.	William Loomis, Ashford, Conn., June 2.
Do.	Jesse Ladd, Holderness, N. H., June 22.
Do.	Simeon Power, Lawrenceville, Pa., June 23.
Do.	Isaac Van Gorder, Warren, Ohio, June 27.
Do.	James Bennett, Brutus, N. Y., July 25.
Do.	Caleb C. Knowles, Fayette, Maine, August 2.
Do.	Anthony C. Carrell, Greenville, Ohio, Oct. 25.
Do.	Joseph Rickey, Centre township, Ohio, Oct. 25.
Do.	Eli Willemin, Salem township, Ohio, Oct. 25.
Do. Balanced lever	Caleb Angevine, city of New York, April 19.
Do. Revolving dasher	Hardin Branch, city of New York, April 18.
Clay, Mixing	Jesse Chapman, Mad River township, Ohio, June 2.
Do. do. & making brick	D. Phillips & J. D. Drummond, Whitestown, N. Y., May 15.
Clocks,	Rufus Porter, Billerica, Mass., June 22.
Do.	James S. Seger, city of New York, Nov. 27.
Do. striking part	George Parker, Ithaca, New York, April 7.
Do. do.	James Bogardus, city of New York, May 18.
Clothes vice,	Samuel Prior, Salem, N. J., March 22.
Coaches, barouches, &c.,	Robert Gedney, city of New York, April 7.
Cock,	Jacob Bright, Sunbury, Pa., June 22.
Do. To prevent freezing in pentstocks, &c.,	Dixwell, Lathrop, Jr., Norwich, Conn., Dec. 5.
Coffee mill, Double	T. H. Wetherly & J. Torrey, Milbury, Mass., July 17.
Do. and spice mill,	E. Parker & H. White, Meriden, Conn., June 22.
Do. do.	Ammi Clark, Berlin, Conn., July 20.
Combs, Preparing tortoise shell, &c.,	Reuben Munsen, city of New York, May 22.
Compass, Surveying	William J. Young, Philadelphia, Pa., Jan. 17.
Constructing boats & vessels	Albert Dorman, Norfolk, Va., Oct. 25.
Cooking apparatus.	S. D. & W. T. Day, Westfield, Mass., June 8.
Do. do.	James Bennett, Brutus, N. Y., July 25.
Do. stove,	Horace Bartlett, Bridgeport, Conn., May 12.

Cooking stove,	Henry O. Foote, Dover, N. H., Dec. 7.
Do. do. Coal	David Gassner, city of New York, April 11.
Do. do. and fireplace,	Edward Potter, Providence, R. I., May 8.
Do. do. Portable	Stephen J. Gold, Cornwall, Conn., Aug. 29.
Do. do. Revolving	Henry Stanley, Poultney, Vt., Dec. 7.
Corn shelling, grinding, &c.	Daniel Mullier, Worcester, Ohio, Jan. 24.
Do. do.	William Gee, Prince George county, Va., May 10.
Do. do.	Christian Thomas, Lancaster, Pa., Sept. 3.
Do. do.	Michael Carpenter, Lancaster, Pa., Oct. 25.
Do. do.	Daniel Hall, Strasburg township, Pa., Nov. 12.
Counterfeit figure, Lathe to prevent	David H. Mason, Philadelphia, Pa., June 7.
Cracker and biscuit cutting,	J. & C. Bruce, King's county, N. Y., March 13.
Croup in poultry, Curing	T. V. Bush, Clark, Ky., June 27.
Cultivator, or harrow,	Waldren Beach, Philadelphia, Pa., Oct. 25.
Cutting sausage meat,	John Brannon, Baltimore, Md., March 8.
Do. do. do.	Charles Otis, Greene, Pa., Nov. 29.
Diamonds, Setting	John Dickinson, Philadelphia, Pa., Nov. 30.
Distilling,	Jacob Miller, Lancaster, Pa., Feb. 16.
Do.	Lewis Johnson, Easton, Pa., Nov. 9.
Dock, Dry	David Brown, city of New York, Feb. 11.
Do. Floating screw	S. H. Stinchfield, New Orleans, La., April 27.
Door fastener,	Calvin Washburn, Bridgewater, Mass, April 18.
Door springs, Vertical wire	John Codman, Boston, Mass., Dec. 28.
Doors,	Eastman R. Ball, Oswego, N. Y., April 5.
Dough, Kneading	N. C. Willett, Jonesborough, Tenn., Dec. 28.
Dyeing with alkaline prussiates,	Felix Fossard, Pittsburg, Pa., Dec. 14.
Faucets, Spring lever	Charles Goodyear, Philada., Pa., March 16.
Felt, Washing, &c., paper-makers'	Samuel E. Foster, Brattleborough, Vt., May 25.
Fenders, Shaping fire	T. Thomas & R. Fuller, city of New York, Nov. 19.
Fire-arms,	J. W. Plummer & J. Clark, Wayne township, Ohio, May 17.
Do.	James B. Porter, Girard, Pa., Aug. 4.
Do. Loading and discharging	P. A. Morineau, Philadelphia, Pa., Oct. 19.
Fireplace for burning coal,	Artemes Torrel, Boston, Mass., Oct. 25.
Flax and Hemp, Breaking & dressing,	Ebenezer C. Chase, Jay, Me., Jan. 6.
Do. do. do.	Arnold Zellnor, Giles county, Tenn., Oct. 25.
Fomentation, Applying, &c.,	T. L. Jennison, Cambridge, Mass., Aug. 30.
Forges, Backs for and other fires,	Philo P. Curtis, Utica, N. Y., March 22.
Do. do. for fires, &c.,	Asa Graham, Hamilton, N. Y., Dec. 25.
Friction rollers,	James D. Cobb, Lebanon, Ohio, June 22.
Fur, cutting from pelt	Denison Williams, city of New York, Oct. 25.
Fur, Separating from hair,	C. Lockwood, R. Lockwood, & J. Arnold, Fairfield, Conn., Dec. 4.
Furnace, Blast, for iron ore,	Thomas Gregg, Connellsville, Pa., May 22.
Do. Hot-air & bake oven	Jacob Stone, Baltimore, Md., May 29.
Garments, Tailors' square delineating	Andrew Weswell, Exeter, N. H., June 7.
Gate purchase, Rotary	I. Musser & L. B. Gitchell, Canton, Ohio, Feb. 11.
Glass, Flattening	John J. Adams, Washington, D. C., April 21.
Do. hones,	A. Gordon & J. P. Bakewell, Pittsburg, Pa., Dec. 8.
Do. Machine for blowing	Joshua Laird, Pittsburg, Pa., Dec. 14.
Do. for orreries, &c.,	Morris J. Gardner, York, Pa., April 30.
Gold, Swinging riddles, &c.,	Oscar Willis, Morgantown, N. C., Sept. 5.
Do. Washing, &c.,	Thomas Rives, Jr., Hall county, Ga., Feb. 3.
Do. do. do.	William Davis, Fauquier county, Va., Nov. 22.
Grates,	James Alwater, New Haven, Conn., Oct. 25.
Gridirons,	F. Bush & L. Pratt, Meriden, Conn., March 28.
Grinding cylinders,	Jonathan Bridges, Troy, N. Y., July 24.
Grist mill,	Gideon Hotchkiss, Windsor, N. Y., Jan. 27.
Do.	Amos Barnes, Colesville, N. Y., April 27.

Grist mill,	Oliver N. May, Hancock, N. Y., May 5.
Do.	Asahel Bacon, Windsor, N. Y., June 4.
Do.	Joseph C. Gentry, Philadelphia, Pa., July 14.
Do. gate pressure,	Seaver Prentiss, city of N. Y., June 4.
Do. scouring & hulling,	D. Parmelee & J. Moores, New Troy, Pa., June 12.
Hair for matrasses, Picking	A. Green & J. S. Osgood, Hamilton, N. Y., Dec. 18.
Harness, Fly net for horses'	Henry Korn, Philadelphia, Pa., June 22.
Harrow, Corn and grain cultivator	Nathaniel Stanton, Jr., Florida, N. Y., July 9.
Do. Cylindrical revolving	James D. Woodside, Washington, D. C., July 28.
Hat bodies,	Seth Graham, Fayette, Maine, May 15.
Hats, Manufacture of	J. Taylor & C. Brown, Danbury, Conn., Jan. 13.
Do. Napping	J. Dart, Jr., W. Wells & D. Olmsted, Buffalo, N. Y., May 12.
Do. do.	H. Wortham & G. S. Petty, Lancaster, Ky., July 9.
Do. Planking	G. & E. Page, Manchester, Conn., Nov. 9.
Do. Washing	Samuel Drinkhouse, Easton borough, Pa., Jan. 30.
Do. Water-proof	Richard Mills, Baltimore, Md., Feb. 27.
Do. do. Stiffening,	George W. Downs, Circleville, Ohio, Oct. 25.
Heat from smoke, Abstracting	Daniel Steinhaver, Philadelphia, Pa., Dec. 13.
Hoe,	Benjamin Hinkley, Fayette, Me., June 23.
Hoes, Fastening handles to	Reener Dare, Greenwich, N. J., Feb. 14.
Horse power,	T. D. Burrall, & J. F. Axtell, Geneva, N. Y., June 13.
Do.	Timothy Shewerman, Covington, N. Y., June 27.
Do. & accelerating motion,	Richard S. Schevenell, Orangeburg, S. C., Nov. 13.
Do. Portable	James H. Corey, Bethel township, Ohio, Feb. 27.
Do. do.	David Flagg, Jr., city of New York, Dec. 28.
Hulling buckwheat, barley,	Thomas Register, West township, Ohio, April 5.
Do. clover seed,	Christopher Seebold, Jr., New Berlin, Pa., March 6.
Do. do.	Geo. Monehon, Augusta township, Ohio, April 27.
Do. do.	Pierson Reading, Trenton, N. J., July 31.
Do. do.	G & E. Faber, Pittsburg, Pa., Oct. 13.
Do. and chopping grain,	G. Wales, Centre township, Union Co., Pa., July 24.
Do. and cleaning grain,	Orin Lull, Otsego, N. Y., Aug. 25.
Do. rice,	Joshua M. Buskey, city of New York, Oct. 25.
Do. do. and barley,	T. F. Strong & M. T. Moody, Northampton, Mass., Nov. 17.
Do. and polishing rice,	J. Beach & S. Starr, Middletown, Conn., May 10.
Do. do. do.	T. F. Strong & M. T. Moody, Northampton, Mass., Aug. 29.
Hydrostatic oil press,	O. Badger & O. Lull, Otsego, N. Y., Aug. 9.
Ice steamboat	Robert Irvin, Baltimore, Md., Jan. 12.
Inclined planes, Propelling cars on	William Bent, Philadelphia, Pa., Oct. 25.
Iron manufacture,	Norman Callender, Reesville, N. Y., July 18.
Iron ore, Separating	Joseph Goulding, Ramapo, N. Y., May 18.
Kiln, Lime	Samuel Griscom, Reading, Pa., June 26.
Lamps, Compound spirits for	William Magee, city of New York, April 27.
Do. Gas	Solomon Andrews, Perth Amboy, N. J., May 10.
Do. tallow, &c.,	Norman Rublee, Montpelier, Vt., Dec. 4.
Lancet, or guard spring,	Samuel Wilmot, Bridgeport, Conn., Oct. 25.
Lathe, Turning	William Green, Bedford county, Tenn., April 27.
Do. do.	John Bisbee, Plainfield, Mass., Nov. 8.
Do. do. chair-tops,	Horatio Cook, city of New York, Nov. 30.
Do. do. whip-stocks,	G. Dayton & A. Mallory, Westfield, Mass., April 27.
Laths, Cutting	Ira Carpenter, Cincinnati, Ohio, May 2.
Do. do. Revolving	Simon Billard, Cincinnati, Ohio, March 16.
Leg and thigh, Extending	Joseph Merrill, Glasgow, Ky., June 22.
Lightning, Protecting vessels from	Elisha L. Keen, city of New York, June 27.
Lime, Spreading	Mark L. Wilson, Quakertown, Pa., June 22.
Lock, Door	James Kyle, Ramapo, N. Y., May 18.
Do. or spring latch,	Robert J. Byram, Boston, Mass., May 13.
Do. Manufacturing	James Meneely, Watervliet, N. Y., Jan. 12.

Lock, Compression cannon	Joshua Shaw, Philadelphia, Pa., Dec. 3.
Do. Percussion	Israel B. Richardson, Palmyra, N. Y., Feb. 17.
Do. do.	Francis Dowler, Wayne township, Ohio, April 9.
Do. do.	David G. Colburn, Port Byron, N. Y., Oct. 25.
Do. Portable cannon	Joshua Shaw, Philadelphia, Pa., Dec. 3.
Marble, Sawing	Isaac D. Kirk, Philadelphia, Pa., July 3.
Marine railway,	Leonard White, Norfolk, Va., Nov. 15.
Medicine, Anti-spasmodic tincture	Horton Howard, Columbus Ohio, Aug. 30.
Do. Astringent tonic	Do. do. do. do. 25.
Do. Bitter tonic	Do. do. do. do. 25.
Do. Compound tincture myrrh.	Do. do. do. do. 25.
Do. Cure for cholera	Jacob Houck, Baltimore, Md., Aug. 25.
Do. Sweating powders	Horton Howard, Columbus, Ohio, Aug. 25.
Milk, Can for	Artemus Crittenden, West Turin, N. Y., July 14.
Mill stones,	David Stern, Vandenburg county, Ind., Jan. 5.
Do. Annular	John Morley, city of New York, Nov. 28.
Do. Bed	William Bennett, Chesterville, Me., Oct. 25.
Do. Dressing	John Keefer, Williamsport, Pa., Jan. 13.
Mineral water, Seidlitz or Rochelle	Joseph Boston, city of New York, May 5.
Do. Soda apparatus	George H. Duffy, Alexandria, D. C., April 19.
Do. Do.	Joseph H. Lanning, Philadelphia, Pa., June 22.
Do. Soda fountain,	J. Fraley & A. Kirkpatrick, Urban, Ohio, May 9.
Moccasins, socks,	Denison Williams, city of New York, Oct. 24.
Nails, Cutting and heading	Emerald Mason, Milton, Vt., June 6.
Do. Manufacturing	Freeman Palmer, Buffalo, N. Y., Oct. 25.
Do. Wrought	Thomas W. Harvey, Jamestown, N. Y., Jan. 4.
Do. do.	John V. Green, city of New York, Dec. 28.
Oakum, Picking	E. Cook & S. Usher, Haddam, Conn., July 9.
Oil cloth, Manufacture of	D. Powers, Lansingburg, N. Y., Feb. 18.
Oil, Fish, whale and sperm	D. C. & C. H. Knapp & A. Howland, Oswego, N. Y., May 29.
Oil, Whale, sperm, cotton seed, &c.	Ephraim C. Moss, city of New York, Dec. 28.
Opium from poppy, Pressing	Lucius Cook, Shrewsburg, N. H., April 20.
Organs, Seraphina	Louis Zwahlen, city of New York, May 5.
Ovens, Tin bake	William Lewis, Franklin, N. Y., Jan. 6.
Packing for steam engines,	William V. Grinnell, Middletown, Conn., April 5.
Paint, or composition for launching,	Winslow, Chandler & Milliken, Unity, Me., June 4.
Do. mill, grain, &c.,	James Bogardus, city of New York, Jan. 18.
Do. do. indigo	Oliver C. Harris, Waterville, N. Y., March 15.
Do. do. dye stuffs, &c.,	William C. Johnson, Philadelphia, Pa., May 3.
Painting, elastic stamp, &c.,	Thomas Boynton, Windsor, Vt., July 12.
Paper making, Filtering for	Thomas French, Ithaca, N. Y., May 26.
Do. Manufacturing	Solomon Stimpson, Newbury, Vt., March 12.
Do. for covered buildings,	Frederic A. Tuft, Dedham, Mass., May 11.
Do. press, Hot and cold cylinder	A. H. Jarvis & T. French, Ithaca, N. Y., Nov. 6.
Do. Sizing	John Ames, Springfield, Mass., Sept. 1.
Pegs or pins, Pointing	James Hull, North Bridgewater, Mass., July 7.
Picker and spreading cotton,	James Whiten, North Bridge, Mass., July 20.
Pins, Manufacturing	John J. Howe, North Salem, N. Y., June 22.
Pipes, Coating with tin	Thomas Ewbank, city of New York, May 16.
Plane, Double iron	William B. Reynolds, St. Clairsville, Ohio, July 7.
Planing machine	Thomas F. Fuller, Bristol, Pa., Oct. 25.
Do. boards, and polishing marble,	Moses Lancaster, Philadelphia, Pa., April 5.
Do. tongueing & grooving	John Drummond, Whitestown, N. Y., April 27.
Do. wood, horizontal knife	Uri Emmons, city of New York, March 6.
Pliers, Cutting	Russel Curtis, Springfield, Mass., Oct. 25.
Plough,	Thomas Whities, Bellefontaine, Ohio, Jan. 14.

Plough,	Samuel Ogle, Adams county, Pa., Feb. 28.
Do.	Joseph Dudley, Fleming county, Ky., May 8.
Do.	George Crowl, Sleepy creek, Va., June 27.
Do.	George Wolf, Fairfield county, Ohio, June 27.
Do.	John Moore, Cynthiana, Ky., Aug. 7.
Do.	Geo. W. Palmer, Jefferson township, Ohio, Aug. 17
Do.	John Weaver, Brownsville, Pa., Aug. 17.
Do.	John Bucks, East Rushville, Ohio, Dec. 28.
Do. Bar share	Moses Huffman, Elizabeth, Tennessee, Dec. 28.
Do. and harrow,	Henry Highly, Canaan, Conn., Dec. 11.
Do. Self-sharpening	Bancroft Woodcock, Mt. Pleasant, Pa., Jan. 26.
Do. do.	Job B. Norton, Utica, N. Y., April 27.
Do. do.	Waldren Beach, Philadelphia, Pa., Dec. 28.
Plugs for ships, Cutting	Daniel Flint, Nobleborough, Maine, April 19.
Power. Propelling mills by lever	William Rhodes, Trenton, Tenn., April 27.
Press, Cheese	Benjamin Hinkley, Fayette, Me., Oct. 25.
Do. do. cider, &c.,	John Holmes, Paris, Me., Feb. 6.
Do. Cotton	David Phillips, Natchez, Miss., April 27.
Do. Flour	Sylvanus Hathaway, Massillon, Ohio, Feb. 13.
Do. Rotary toggle-joint	Thomas W. Harvey, Jamestown, N. Y., April 27.
Do. Standing	Aaron Hale, Boston, Mass., June 26.
Do. Tobacco	George Booker, Richmond, Va., Feb. 8.
Do. Wedge	Oliver Perkins, Oxford, Me., Aug. 8.
Printing machines,	John Hatch, Boston, Mass., March 21.
Do. press, Faustus	Seth Adams, Boston, Mass., May 23.
Propelling boats,	Jarvis Ring, Ogden, N. Y., Oct. 25.
Do. canal steamboats,	I. Sheffield & I. Ingraham, Erie county, N. Y., May 17.
Pulp dresser,	Coleman Sellers, Philadelphia, Pa., June 6.
Do. Preparing and dressing	John Ames, Springfield, Mass. Sept. 1.
Do. strainer,	James Sawyer, Newbury, Vt., Jan. 21.
Pumps,	Moses Bucklin, Grafton, N. H., Oct. 25.
Do. Air, or ventilator	G. Harly & I. Sedgwick, Philadelphia, Pa., June 1.
Do. Spiral	Cotton Foss, Perry, Ohio, Aug. 4.
Do. Valve spring, or drop	Eli Kendells Ashby, Mass., June 22.
Punching holes in raw hides,	William Angell, Providence, R. I., July 19.
Do. Iron, steel, &c.,	James Bennett, Brutus, N. Y., July 25.
Rags, Cleaning	George Curriel, Manchester, Conn., Feb. 7.
Do. do. and dusting	Samuel E. Foster, Brattleborough, Vt., June 1.
Railroad cars,	Jedediah Richards, Elbridge, N. Y., March 9.
Do. switches,	William Howard, Baltimore, Md., Aug. 2.
Raising water,	L. Disbrow & I. Sullivan, city of New York, Aug. 28.
Do. do.	Philip Tusing, Broek's Gap, Va., Nov. 7.
Do. do. by steam,	David Colver, Deer Creek, Ohio, June 6.
Rifles, Cane	Roger N. Lambert, Upton, Mass., Feb. 27.
Do. Manufacture of	J. W. Plummer & J. Clark, Wayne township, Ohio, May 17.
Rivets for copper,	George W. Sowle, New Bedford, Mass., May 11.
Ruler, Parallel	James Carrington, Wallingford, Conn., April 14.
Ruling paper,	Alfred Hathaway, Troy, Mass., Dec. 31.
Saddles, Steel spring, worm	George Pritchard, Clarkburg, Va., May 3.
Do. trees, Harness	Philo Washburn, Taunton, Mass., March 8.
Salt, Manufacturing	Calvin Guiteau, Geddes, N. Y., Oct. 25.
Saw, Gumming	Jeremiah Case, Sodus, N. Y., Oct. 25.
Do. Manufacturing	Stephen Ustick, Washingtcn, D. C., Aug. 11.
Do. Set, for mills,	Norman Urquhart, Madison county, Ala. Feb. 7.
Do. for cutting Laths, Circular	Francis Shumard, Cincinnati, Ohio, Oct. 31.
Do. strainer,	T. V. Leroy, & A. Sanford, Newport, N. Y., July 25.
Do. mills,	Vachael Blayloch, Bellefontaine, Ohio, March 24.
Do. do.	John R. Drake, Oswego N. Y., April 27.
Do. do.	Levi Chapin, Walpole, N. H., June 1.
Do. do.	David W. Hall, Sparta, Geo., Nov. 27.
Do. do. Blockhead for	John Sinclair, Richland, Ohio, Feb. 28.

Saw mill, circular railway, &c.,	Allen B. Reynolds, Cincinnati, Ohio, June 29.
Sawing circles,	Thomas Armstrong, Hamilton county, Ohio, July 18.
Do. wood,	T. Blood & S. A. Hurd, Fairfield county, Conn., May 22.
Screws, Cutting endless	John H. Shrader, Philadelphia, Pa. Oct. 25.
Shell and shot, Elongated spiral	W. P. Pier & A. Mack, Detroit, Mich. April 6.
Shingles, Cutting	George Wolf, Clearcreek township, Ohio, March 22.
Do. Sawing	D. McArthur & T. McKibbin, Urbano, Ohio, Feb. 15.
Do. & staves, heading, &c.,	David Flagg, Jr., city of New York, Dec 28.
Shot, Manufacturing buck	John Snyder, city of New York, Jan. 26.
Silk reel,	Eliphalet Snow, Mansfield, Conn. March 16.
Do. do.	Charles G. Green, Windsor, Ver., May 31.
Smoke ventilator,	Silas Smith, Hamilton, Ohio, March 17.
Smut machine,	Stephen Fellows, Sandwich, N. H., May 24.
Do. do.	Nathaniel Wimslow, Poughkeepsie, N. Y., Oct. 26.
Spade, Socket	C. Richmond & H. Caswell, Jr., Taunton, Mass., July 13.
Spinning, Roping cotton	John A. Bradshaw, Foxborough, Mass., Dec. 8.
Do. Spindle cotton	Nathaniel Rider, Dudley, Mass., Nov. 3.
Do. throstle frame	Seth Simmons, Providence, R. I. Jan. 16.
Do. Wool	Calvert, Southwick, & Messenger, Lowell, Mass., March 31.
Do. do. and cotton	David Newbrough, Ridley township, Ohio, April 27.
Spools and bobbins	Simeon Prestrey, Jr., Canton, Mass., July 26.
Spoons, Manufacturing	Charles Goodyear, Philadelphia, Pa., Aug. 11.
Stairs, Circular, &c.	Edward B. Smith, Buffalo, N. Y., Nov. 15.
Staves, jointing, &c.,	Philip Cornell, Brutus, N. Y., April 11.
Steam engine,	Stacy Costill, Philadelphia, Pa., Feb. 20
Do. do.	Lafayette Tibbitts, New Glasgow, Va., June 22.
Do. do. locomotive, & cars,	S. H. Long, Philadelphia, Pa., Dec. 28.
Do. do. Rotary	Luther Carman, Oxford, Me. July 16.
Do. do. do.	William Jones, Bradford Va., Nov. 10.
Do. to machinery, Applying	Seth Boyden, Newark, N. J., Oct. 31.
Do. Generating & applying	Benjamin Phillips, Philadelphia, Pa., Jan. 31.
Do. power, Increasing	N. P. Goodell, Kirtland, Ohio, Jan. 23.
Steering ships, &c.,	Elijah Soule, Duxbury, Mass., Nov. 3.
Stereotype blocks,	Samuel Sawyer, Boston, Mass., May 28.
Do. do.	Bradbury Haskett, Boston, Mass., May 21.
Do. do. Fastening cam and spring	Abel Chandler, Concord, Mass., July 13.
Stock,	Edmund Badger, Philadelphia, Pa., April 5.
Do. Gin sawing	Abraham Myers, Boonsborough, Mass., Nov. 9.
Stone, &c., Dressing	Clark Miller, Williamsport, Pa., Feb. 14.
Stoves	Nathan Parrish, Mendon, N. Y., Nov. 2.
Do. Anthracite coal	Jordan L. Mott, City of New York, May 30.
Do. do.	Eliphalet Nott, Schenectady N. Y., Oct. 25.
Do. and chimney's construction.	Asa Graham, Rumford, Me. Dec 28.
Do. and furnaces.	Ephraim Baldwin, Gibbonsville, N. Y., July 19.
Straw, hay, &c., Cutting	Jacob Harland, Tompkinsville, Ky., April 19.
Do. and Leghorn Bonnets, Pressing	Otis Plimpton, Foxborough, Mass,, Dec. 28.
Stumps of trees, Removing	John E. Larkin, Salem, N. Y., Oct. 25.
Syphilis, medicine for the cure of	Nicholas Badeau, city of New York, March 8.
Tan vats, or letches,	William Brown, Herkimer, N. Y., June 28.
Tanning hides, liming, &c.,	Caleb Hawk, Monroe county, Va. May 3.
Do. leather,	Joseph Blunt, city of New York, Nov. 30.
Do. Preparing hides for	Lewis Newsom, Gallipolis, Ohio, March 8.
Do. without use of lime,	Edward Evans, Salem township, Pa. Dec. 28.
Tenons, Sawing	Charles Thompson, Poughkeepsie, N. Y., Dec. 6.

Threshing machine,	Orlando Hurd, Bridgeport, Conn., Jan. 23.
Do. do.	Nathaniel Adams, Westmoreland, N. Y., March 2.
Do. do.	Hardin Branch, city of New York, April 18.
Do. do.	Samuel Cable, Beaver Creek township, Ohio, May 10.
Do. do.	M. S. Flaglor, city of New York, July 7.
Do. do.	Squire Campbell, Onandaga, N. Y., Oct. 26.
Do. do. and grist mill,	Matthew Wilson, Springfield, Va. April 18.
Do. and shelling corn and grinding apples,	Jesse Bevier, Sempronius, N. Y. Dec. 11.
Tile and current mills,	James Bennet, Vigo county, Ind., Aug. 10.
Tin kitchen,	George Richardson, South Reading, Mass., June 14.
Tobacco segar fillers, Preparing	Joseph Maffet, Lancaster, Pa., May 16.
Tonsillarum sector,	Wm. B. Fahnestock, Lancaster, Pa. May 25.
Tools, Holding and grinding	George A. Medeira, Chambersburg, Pa., April 19.
Truss for vessels,	Jonathan T. Quimby, Belfast, Me., Jan 30.
Valve, Face plate	Stacy Costill, Philadelphia, Pa., April 13.
Do. Safety piston	John C. Douglass, city of New York, Jan. 30.
Do. Sliding	Thomas Halloway, Philadelphia, Pa., Jan. 20
Do. for vibrating steam engine,	Do. do. do. 20.
Do. Wing gudgeon	Do. do. do. 20.
Varnish to whipstaffs, Applying	Frederick Morgan, Westfield, Mass., April 27.
Ventilating machine,	G. Harley & J. Sedgwick, Philadelphia, Pa. June 1.
Do. vessels, &c.,	Jesse Remington, Baltimore, Md., March 1.
Visors for caps, Cutting leather	Jacob Hawkins, Roxbury, Mass., Feb. 20.
Warming rooms, &c.,	Robert B. Varden, Baltimore, Md., Feb. 6.
Washing machine,	Silvanus Hathaway, Massillon, Ohio, Feb. 13.
Do. do.	McAll, Higgins, & Rogers, Athens, Ohio, Feb. 15.
Do. do.	D. G. Wilson, Machias, Me., April 6.
Do. do.	Simeon Savage, E. Machias, Me., April 11.
Do. do.	Sylvanus Menton, Pendleton, S. C., April 14.
Do. do.	Benton P. Coston, Philadelphia, Pa. April 27.
Do. do.	I. S. E. Pulsifer, Ipswich, Mass., May 21.
Do. do.	Ezra Fisk, Fayette, Me., May 25.
Do. do.	Ebenezer Mayo, Hallowell, Me., May 26.
Do. do.	Ira Avery, Springfield, Pa., June 22.
Do. do.	N. Howe & J. McCollam, New Petersburg, Ohio, June 30.
Do. do.	Isaac S. Wright, Weedsport, N. Y., July 18.
Do. do.	W. W. Woodburn, Greensburg, N. C., Juy 18.
Do. do.	W. H. Cummings, Guilford, N. C., Nov. 3.
Do. do.	Eli Nicholls, Union township, Ohio, Nov. 24.
Do. do.	Jacob Lindsay, Canajoharie, N. Y., Dec. 28.
Do. do. and drying	Thomas Pearce, Hartwick, N. Y., Dec. 29.
Do do. and scouring	N. Morrison & J. Lewis, Uniontown, Pa., March 14.
Do. do. do.	Camm Moore, Guilford county, N. C., Oct. 30.
Water, Supplying houses with	William Bryant, Davidson county, Tenn., Oct. 25.
Do. Power to a number of wheels,	Henry Crenshaw, Anderson district, S. C., Dec 28.
Do. wheel,	James McConnel, Shenango, Pa., Dec. 13.
Do. do.	John Moffit, Richmond, Ohio, April 17.
Do. do. Chain action	Sandford Reynolds, Pitcher, N. Y., Dec. 15.
Do. do. do. paddles,	Davidson Myers, Benton, Mo., Sep. 4.
Do. do. folding ladle boards	Thomas Winslow, Jay, Me., Oct. 25.
Do. do. Horizontal	Sheldon Stoddards, Jackson township, Pa., May 28.
Do. do. do.	Asahel Baron, Windsor, N. Y., June 4.
Do. do. do.	J. Nuchols & S. P. Wheeler, Boliver, Tenn, June 22.
Do. do. Inclined	Cotton Foss, Perry, Ohio, Aug. 4.

Water wheel, Reacting	G. W. Henderson, & J. Russel, Milburn, Me., Sep. 22.
Do. do. do.	Gideon Hotchkiss, Windsor, N. Y., Nov. 6.
Do. do. and sawmill,	Charles Forse, Booneville, Miss., Aug. 24.
Wheels and axles of locomotives, &c.,	Richard Berrian, city of New York, Nov. 13.
Do. boxes, Setting	Josiah Chancy, Chesterville, Me., Oct. 25.
Do. do. hubs, &c.,	David Watson, Fayette, Mass., May 29.
Do. Drilling & boring car	Dean Walker, Gunpowder, Md., Dec. 28.
Do. Bending felloes of	Tristram Kimball, Salem, N. H., Jan. 16.
Do. hubs, Cast iron	John Thurston, Providence, R. I. Dec. 3.
Do. do. Cutting and boring	John B. Francis, Loudon county, Va., March 2.
Do. Cutting tenons on spokes of	James Smith, Fayette, Me. June 7.
Winch and gin for loading vessels	Eleazer Allen, city of New York, Feb. 29.
Wind wheel for propelling boats &c.,	Benjamin Dugdale, Trenton, N. J., May 3.
Do. do. or water,	Adkins Nash, Addison, Me., April 27.
Do. do. Horizontal	Jeremiah L. Coleman, Vincennes, Ind., May 4.
Window sash,	Charles Thompson, Poughkeepsie, N. Y., Dec. 6.
Wine from cider,	Jacob Hugus, Hempfield, Pa., Oct. 1.
Winnowing clover seed,	George Faber, Chambersburg, Pa., April 5.
Do. grain, &c,	A. Look & W. Coleman, Jr, Fredericktown, Md., March 21.
Do. machine, fanning mill,	Samuel Fitch, Edmeston, N. Y., Jan. 6.
Do do. do.	P. Prine & L. Huestis, Auburn, N. Y., Feb. 23.
Do. do. do.	David Clinton, New Haven, Conn., Nov. 22.
Do. do. do.	Hunter, Hunt, & Holman, Oakland county, Mich., Dec. 18.
Do. mill machinery,	James Ruple, Washington, Pa., May 19.
Do. do. do.	Daniel Davis, Cornish, N. H., July 5.
Wrench, rack	Henry King, Springfield, Mass., Oct. 25.
Yarn, Dressing preparatory to weaving	Samuel Batchelder, Saco, Me., June 22.

BIBLIOGRAPHICAL NOTICES.

Gillespie on Road Making.

"A Manual of the Principles and Practice of Road Making: comprising the location, construction, and improvement of Roads (common, Macadam, paved, plank, &c.,) and Railroads. By W. M. Gillespie, A. M. C. E., Professor of Civil Engineering in Union College, New York. Published by A. S. Barnes & Co., 1847."

This small volume contains much valuable matter, derived from the best authorities, and set forth in a clear and simple style. The subject upon which it treats is one of great importance, and it would be a useful book in the hands of all persons employed in laying out roads, and especially common roads in our country. For the want of information which is contained in this manual, serious mistakes are frequently made, and roads are badly located and badly constructed by persons ignorant of the true principles which ought to govern in such cases. That branch of civil engineering which relates to the improvement of common roads has been much neglected in our country, and the care of them has been very generally entrusted to incompetent hands; but, by the extensive circulation of such books as that now

before us, and the imparting of sound views on the subject to the students of our collegiate institutions, we may hope for a change for the better in this respect. The number of persons competent to do the work well will be increased, and the conviction will become general that no one ought to be entrusted with the laying out or constructing of a road, unless he has first studied the subject and made himself fit for the duty which he undertakes to perform.

Morfit on Perfumery—its Manufacture, Use, &c., &c.

Perfumery,—its Manufacture and Use, &c., &c.: from the French of Clenart, and other late authorities; with additions and improvements. By Campbell Morfit, Esq.

This is a neat manual of perfumery, and contains many processes and recipes which will be of use to those who interest themselves with that art and its products. The explanations are clear, and the matter of the work is as creditable to the compiler as the manner in which it is got up is to the publishers, (Messrs. Carey & Hart.) It, however, would be much improved by the addition of an index. We regret to see that the style occasionally shows marks of carelessness and of inexcusable haste; thus, (page 14,) it is stated that "the sale of an article is *in a ratio proportional to the price;*" and, (page 254.) "the flotant soaps" (why not use the English term, *floating soaps?*) "owe their title to the mechanical operation by which their *weight is lessened one-half, without a corresponding diminution of bulk.*" The constant affectation of French terms renders the style flippant, and produces an impression unfavorable to the author. A technical author cannot be expected to write elegantly, but there is every reason why he should be more than usually careful to write correctly. Again, when a quotation from the scriptures is necessary, the authorized version should, except under very peculiar circumstances, be adhered to, and great care should be taken to have the passage literally correct. This has not been done in the passages cited in the preface of this work, and in the second case, (Exod. xxx, 34–35,) the use of the word *confection* as a verb is at once a departure from the authorized version of the scriptures, and the authorized rules of the language.

We have been more particular in noticing these defects, as we understand that the young and promising author is engaged in another and more original work upon an important branch of technology, and we should be glad to find that, by a little attention to matters of this kind, which are, we are sorry to say, generally too much neglected, he has added purity of style to his excellent knowledge of his subject, and thus rendered his work creditable to himself and his country.

F.

FRANKLIN INSTITUTE.

Demonstrations by means of Models.

At the monthly meeting of the Franklin Institute, held May 20th, 1847, the following statements and computations relative to Mr. Herron's model of a railroad bridge, which the inventor then exhibited, were made by *Prof. W. R. Johnson:*

Mr. Herron had stated that his bridge was intended to have a clear opening of one hundred and fifty feet, a height of sixteen, and a breadth of twenty-two feet, and to bear a load equivalent to two trains of twenty-ton locomotives placed close together throughout its length, and which he supposed would be equivalent to two tons per *foot of length* of the structure. He also stated that the model was constructed on the scale of one inch to a foot, and that the proportion of parts had been preserved throughout. The model had been weighed just before the meeting, and 150 inches of its length were found to weigh 136·3 pounds. He also mentioned that it had been subjected for many hours to a weight of 3080 pounds distributed over its length, and to more than 1700 pounds accumulated near the centre. This latter load had been accompanied by rather violent motions, on the model, of a part of the load, consisting of the weight of two or three heavy persons, who, by rising a short distance and then coming down with nearly their whole weight, were able to communicate shocks more than proportional to those which the large structure could receive from the passage of trains.

Prof. Johnson observed, at the commencement of his remarks, that the plan of solving questions in practical mechanics and engineering by faithfully constructed models, presented the very obvious advantage of substituting the moderate cost of *experiment* for the often burthensome, sometimes ruinous, expense of *experience*. This method has wisely been adopted by the engineer entrusted with the building of a railroad bridge over the celebrated Menai Strait; and the liberal expenditure understood to have been made under the control of Messrs. Fairbairn and Hodgkinson, to prove experimentally the value of different plans of construction for rigid iron bridges, proves the estimation in which this method of solving practical questions is held among the engineers and practical mechanics of Great Britain.

The conditions to be fulfilled in constructing *models* so as to give reliable information in regard to the action or the stability of *structures*, were stated as follows:—

1. An entire correspondence in the *model*, at least of all *essential parts*, to the *scale* of dimensions and weights on which it is proposed to represent the *structure*.

2. Identity not only in the nature, but also in the condition, of materials employed in the model and structure respectively.

3. Proportional accuracy in forming junctures; and proportional tensions given by tightening-screws, keys, wedges, and other mechanical means by which the parts are compacted together.

In testing the model, modes of introducing, distributing, and withdrawing the loads, conformable to those which practice will involve in regard to the structure, must be observed, so as to subject the model to shocks, jars, inequality of pressure, and irregularities of application, at least proportional to those which the structure will be required to sustain.

Supposing the model to have been constructed according to the above requirements, it might be used for either of the two following purposes:—

1. *To determine what weight the structure will bear when undergoing a given deflection, or when on the point of breaking.*

2. *To ascertain whether the principle of construction adopted by the inventor, be adequate to furnish a bridge of the proposed dimensions and materials that can fulfil the specified duty.*

The latter problem is the one more particularly intended to be solved by the use of the model in question.

As a beam or bridge of uniform dimensions throughout will bear half as much weight accumulated at the centre as it could sustain if distributed throughout its length; the simplest mode of arriving at the result desired, is to determine and apply to the centre of the model a weight which shall represent one half the load supposed to come upon the structure.

The following formula, essentially similar to that of Gregory, applies to the loading of the model at its centre:

Let l = the length of the model in feet, between the points of support. ($=12^3$.)

w = the weight of so much of it as lies over the clear opening between the piers.

p = the weight in pounds which it is to sustain at the centre, when bearing a load, representing the two trains of heavy locomotives.

r = the ratio of dimensions between the *structure* and the *model*. ($=12:1$.)

P = the *load* which the structure must be able to bear accumulated at the centre ($=150$ tons.)

Then it is evident that $r\,l$ = the length of structure between the piers. ($=150$ feet.)

And since the relative resisting powers of similar beams or bridges are as the second powers of their corresponding dimensions, $\therefore r^2:1 =$ the relative resisting powers of the *model* and *structure*.

Hence, $r^2\,(p+\frac{1}{2}w)$ = the absolute resisting power of the *structure*.

Also, since the *weights* of similar structures are as the third powers of their corresponding dimensions, or, what is the same thing, as the third powers of their *ratios of dimension*, therefore, $r^3\,w$ = the absolute weight of the *structure;* so that the weight P, which, by supposition, the structure can bear, accumulated at its centre, will be its absolute resisting power, diminished by half its own weight.

Hence, $P = r^2\left(p+\frac{w}{2}\right)-\frac{r^3\,w}{2} = r^2\,p-\frac{r^3\,w+r^2w}{2} = r^2\,p-r^2(r-1)\frac{w}{2} =$

$r^2\left(p-\frac{w}{2}\times\overline{r-1}\right)$.

But as, by supposition, P is known, and it is desired to find p, the conversion of the last formula gives $p = \frac{P}{r^2} + \frac{w}{2}\left(r - 1.\right)$

In order to determine whether any, and, if any, what class of locomotives could, if composing two entire trains, load a bridge with a weight of two tons per foot of length, Prof. J. presented the following table, derived from information received from Mr. Baldwin's factory, as to the weights and lengths of the several classes of engines, including the *bumpers*:—

Class.	Weight of engine in tons, including water.	Number of wheels.	Length of engine in feet.	Tons weight of locomotives on 300 feet of single track.	Tons on each foot of bridge when loaded with two trains of locomotives.
1	25	8	24	312	2·08
2	20	6	22	272	1·81
3	20	8	23⅞	251	1·68
4	17	6	21	243	1·62
5	18	6	22½	240	1·60
6	15	6 or 8	21	214	1·43
7	12	6	19½	185	1·23

From this it appears that no class of engines, except that of 25 tons in weight, could possibly load the bridge with so much as 300 tons. Twelve engines of that class placed on the bridge, about fourteen inches apart, *would* form the load assumed by Mr. Herron. To compute the load on the centre of the *model* which shall represent this load on the structure, we substitute the values of the several symbols in the equation $p = \frac{P}{r^2} + \frac{w}{2}\left(r - 1\right)$, and obtain

$$p = \frac{300 \times 2240}{144} + \frac{136{\cdot}3}{2} \times (12 - 1) = 30{\cdot}2 \text{ pounds.}$$

Twice this sum, or 6164 pounds, is the weight which the model ought to bear distributed over its length, or about double the load yet put upon it.

The bridge of Mr. Herron is to be composed of stringers, cross ties, braces, and uprights of *wood;* and diagonal braces both in the horizontal and vertical planes, formed of *iron* screw bolts. In this latter particular the model does not fulfil the second of the above conditions.

It wants identity of condition in the materials. Iron in the state of unannealed *wires* is used instead of rolled or hammered *bolts*.

By reference to the Report of the Committee of the Franklin Institute on the strength of materials for steam boilers, pages 158 and 244, it is found that good iron *wire* possesses a strength of 81,000 pounds per square inch; while at pages 152—157, it appears that good bolt iron possesses, in its ordinary state, a strength of about 60,000 pounds

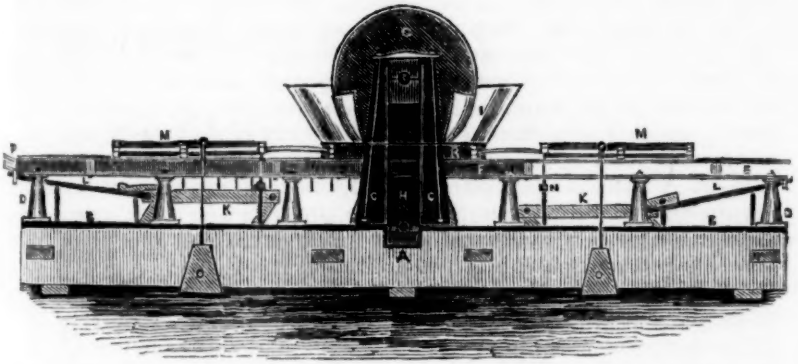
per square inch. Hence the relative resisting power of the model, so far as it depends on its iron braces, is $\frac{7}{20}$ greater than that of the structure will be.

Committee on Science and the Arts.

Report on Culbertson's Brick Press.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, to whom was referred for examination a Dry Clay Brick Press, invented by Mr. T. Culbertson, of Cincinnati, Ohio, Report:—

That Mr. Culbertson exhibited, at the hall of the Institute, a beautiful model of his machine, which combines, in an eminent degree, the merits of simplicity, ingenuity, and utility. He also furnished the following drawing and explanations, which clearly illustrate its construction:



In the above wood cut, A represents the sills upon which the machine rests; B, cast iron bed plates, resting upon, and bolted to, the sills; C, C, posts which sustain the press wheel G; D, D, posts upon which the slides E rest, and through which they are strongly bolted to the bed plates; F, carriage containing fourteen moulds, each of which is provided with a movable bottom, or follower, which rests upon the bottom plate of the carriage. To each of these followers two stems are attached, which project through the bottom plate. The carriage is guided in its movements by embracing the four slides E, and receives the reciprocating motion from a crank, or other mechanical equivalent movement, by means of a connecting rod, or pitman, P. The extent of the motion to the carriage is such, that the whole set of moulds pass under the press wheel G each way, thus equalizing the density of the brick. The press wheel G, is placed vertically over the bearing roller H, and above the moulds—its journals turn in boxes, which are strongly secured between the vertical posts C, C. H is a

friction or bearing roller, upon the periphery of which the mould carriage rests, and is sustained under the pressure necessary to force the clay into the mould; I, hoppers, into which the clay is thrown; R, clay-box, upon which the hoppers rest, and in which the press wheel works. This clay-box is made fast to the posts C, C, its lower edges being as near to the face of the moulds as possible, so as not to rest upon them. In each end of this clay-box a knife is placed ranging with the face of the moulds, so as to shove off all the surplus clay; K, K, parallel levers, to which are attached rods L, L, upon the ends of which nuts or washers are placed in such position as to be struck by, and carried forward and up with, the carriage, as seen on the left. Thus raising the brick out of this end or half of the moulds by the horizontal movement of these levers corresponding with that of the carriage, all tendency to cant the followers, strain or bind the stems, is avoided. As soon as the bricks have been carried up above the upper surface of the moulds, a projection on the side of the carriage comes in contact with, and moves an arm on, the vertical rocking shaft N, which has another arm that gives a lateral movement to the parallel levers M, by which the bricks are shoved off the carriage on a table. The bars M are brought back to their original position by the weights O, O.

Various efforts have been made, for a number of years, in this and other countries, to apply machinery to the manufacture of bricks, for the purpose not only of economizing time and labor in the process, but of securing an exactness in shape not attainable in moulding by hand. In these experiments the practicability of making bricks by compressing clay in its natural state, has been fully tested.

When composed of suitable material, bricks made in this way have been subject to various tests, and have proved to be fully equal to those made in the ordinary manner. In the numerous machines invented for this purpose, practical difficulties have arisen which have not hitherto been entirely overcome. But this machine is simple in its construction, has few wearing surfaces, is not very expensive, requires comparatively little power to drive it, and needs but few hands to attend it. It is self-feeding and self-delivering; it is constructed to make from 2500 to 3000 bricks per hour, it requires no preparation of the clay, and no yard room for drying, as the bricks are sufficiently hard when they come from the press to stack up in the kiln; they are also of a uniform size, and are harder, smoother, and, being less porous, will absorb less water than ordinary brick. The pressure being gradual and continuous, the air is permitted to escape freely as the clay is forced into the moulds. Also, as each mould passes twice under the cylinder, first in one, and then in the opposite direction, and receives clay from the hoppers each way, it (the mould) is pressed full in all the corners and edges, and the different particles of clay are, by this rolling or kneading process, thoroughly united.

By a slight alteration of the moulds, bricks of any desired shape, or size, (suitable for paving, lining cisterns, building arches, &c.,) may be formed. The machines are so constructed that they can be taken to pieces and put together with great facility, thus rendering them portable. As the works will all be under cover, bricks can be made as

well in wet as in dry weather; they can also be made later in the fall and earlier in the spring than by the ordinary process, the dry brick being less subject to the action of frost. As they require no drying, but are carried from the platforms directly to the kiln, the expense and liability to accident from being twice handled, and the injury from exposure to rain, are avoided.

The committee also examined two burnt bricks made by this machine, which, on breaking, they found were very strong, compact, and thoroughly burnt.

The committee are of opinion that the machine is a highly valuable invention, and that it is destined to introduce an entire revolution in the process of manufacturing bricks heretofore adopted.

It is proper to state that although the patent of Mr. Culbertson is only for certain improvements on a prior machine, invented and patented by Mr. Parson Owens, he has become the proprietor of both patents, and, therefore, as it is a matter of no concern to the public, the committee have not thought it necessary to specify what parts of the machine were the invention of each of the original patentees.

By order of the Committee,

WILLIAM HAMILTON, Actuary.

Philadelphia, June 10, 1847.

MECHANICS, PHYSICS, AND CHEMISTRY.

An Account of the Construction of the New Lighthouse at the Port of Havana. *By* SENOR DON JOSE BENITES, Colonel of Royal Engineers.

Translated from the Spanish, for the Journal of the Franklin Institute.

The improvement of the light at the Moro castle, which serves as a guide to vessels entering the port of Havana, in such manner as to correspond not only with the importance of its commerce, but also with the perfection to which the construction of this kind of apparatus has now attained, having been determined upon by the Royal Junta of protection, the department of the Marine was naturally consulted with regard to the most eligible situation and the proper altitude of the new light.

That illustrious body was of opinion that a light placed at the same entrance to the port as the former one, would be preferable to a light elsewhere, although it might be situated on a more elevated point of the coast, owing to the particular configuration of which, it might be seen from further to the windward. With regard to the height, it was judged sufficient to give an additional elevation of 25 feet to the old tower, because the light, being thus placed at 142 feet* above the level of the sea, would overlook the point called Del Pajonal, which

* The Spanish *foot* here used is equal to 11·1 inches, and the *vara*, or yard, is 33·3 inches.

bears about N. 71° E., and might, therefore, be readily distinguished and recognized by vessels approaching the port from that direction, within not less than eight nor more than fifteen miles of the coast, and affording still greater advantages to those standing in more from the northward. And, moreover, that with the proposed elevation, this lighthouse would be one of the highest which are known.

In accordance with this report, the Junta determined, on the 22nd of April, 1840, to proceed with the execution of the work, and its President, the Most Excellent Captain General, directed that the corps of engineers should make the proper examination, in order to ascertain the practicability of giving to the old tower the desired additional elevation. By a report of the commandant, June 2, 1840, it was declared practicable to add the proposed 25 feet to the height of the tower, provided the work were carefully done, and with materials of the best kind.

In this state the project rested until the 16th of October, 1843, when the Junta, through its President, asked that the funds necessary for the work should be remitted; inasmuch as it would also be necessary, in addition to the projected increase in the height of the tower, to order from Paris a lenticular lantern of the most improved kind, by Fresnel, to be placed therein. The requisite funds having been provided, it was resolved, on the 7th of April, 1844, to proceed with the work, but with the indispensable condition that the light should not be interrupted for a single night. Accordingly, the construction of a small temporary tower was commenced on the 22nd of May, for the purpose of sustaining the light while the height of the old tower was being increased by additional mason work. The great height of the platform upon which the temporary tower was constructed, rendered it unnecessary to give it an elevation of more than seven yards, in order to maintain the light at the same height as that at which it was placed in the old tower. Its immediate proximity to this, and the removal of the light to the temporary tower in a single day, rendered it unnecessary to give that notice in the public papers which would otherwise have been requisite in order to avoid dangerous consequences to vessels. On the 23rd of July, 1844, the temporary lighthouse was first put into use; its cost, including the lantern, amounting to the sum of $1800. Its strength, and the judicious principles upon which it was constructed, were fully proved in the terrible hurricane of the 5th of October last; during which, though exposed, without the least protection from other buildings, to the force of the wind and the beating of the waves, it remained firm, and without other injury than a total destruction of the glass in the lantern.

The next step was the taking down of the lantern from the old tower, and to proceed with other preparations for increasing its height, when, on the 14th of August, 1844, notice was received by the board of engineers, from his Excellency, the Captain General, that, by a resolution of the Junta, adopted in virtue of a report from their commissioners, it was determined to suspend the work, and inquire whether it would not be more expedient, provided the funds were sufficient, to construct a tower upon a new plan, which should combine all the

beauty, convenience, and facility which would be required for the proper management of an apparatus so complicated as that of Fresnel; advantages which could not be afforded by the old tower, on account of its limited dimensions, and its total want of accommodations for the persons entrusted with the care of the light during the night, as well as its narrow and inconvenient stairway. The board of engineers, as was to be expected, reported in favor of the new project, and at the same time submitted a plan and an estimate for the new tower. Both of these were approved by the Junta at its session on the 16th of August, and the work was ordered to be carried into effect. On the following day, the demolition of the old tower was commenced, and, at the same time, the excavation of a foundation for the new one was begun, in order that the old materials might be used in it.

Situation of the New Tower.—Of the rock upon which the Moro castle is built, that point which extends furthest towards the N. W., and on which the old tower stood, is divided from the rest by a cleft, or fissure, and is also undermined by a large cavern, washed out by the continual beating of the waves. In order to avoid these defects, which might, in time, endanger the stability of the new edifice,—and also because the space afforded for the ground plan was not sufficient, a place was chosen 84 feet further back than the position occupied by the old tower, and on the broadest part of the glacis of the Morillo, a position combining all the advantages of the former one, besides leaving free the extreme point of the Morillo, for the erection of a battery of three Paixhan guns, of large calibre, in such a very advantageous position. Care was also taken to leave sufficient space about the new tower for the free use and management of the cannon which defend the entrance to the port, as well as of those on the opposite side.

Description of the Tower.—It is composed of two parts; the first representing a column 79 feet high, 25 feet in diameter at the base, and 20 at the top. The cornice of this serves as the floor of a corridor with a circular parapet, enclosed by a grated railing of copper, which surrounds the upper, or second part, upon which the lantern is supported. The first, or lower part, is constructed of hewn stone; the wall being seven feet thick at the base; vertical in the interior, and sloping on the outside, 30 inches in the whole height. The interior space of 11 feet in diameter serves for a circular staircase, the steps of which are four feet long, 7½ inches high, 19 inches broad at the wide end, and six at the other, or immediately at the spindle, or central column of three feet in diameter, which extends up through the whole height. The stairway begins inside, at 38 inches in the clear from the door, in order to leave an open landing place; the steps being covered with slabs of marble 1½ inches in thickness, with a moulding which extends an inch beyond the step. The doorway in the lower part of the tower, which gives entrance to the stairway, is four feet wide and eight feet high, with pilasters at the sides; and its cornice and frontispiece in the form of a circular arch. Over the door is a block of marble containing an inscription in Spanish of the following purport:—

In the year 1844:
Isabella the Second reigning;
The Junta of Protection under the Presidency of
the Captain General of the Island, Don Leopold O'Donnell;
This work was executed under the direction of
the Corps of Engineers of the Army.

The stairway is lighted and ventilated by three sets of windows, placed equi-distant from one another throughout the whole height. They are four feet high and two feet wide, and in six of them, the lower part of the niche, or recess in the wall, which forms the window, is level with the steps, and serves as a landing, or resting-place. Below the stairway, and at the level of the lower floor of the tower, is a spacious room, enclosed by a wooden railing, which is used as a place of deposit for oil, and the more heavy and bulky articles used about the lighthouse.

At the height of 63 feet 9 inches, the stairway which has been described terminates in an apartment called the attendant's room, 12 feet in diameter, and 12½ in height, covered by an arch two feet thick in the crown. This chamber, lined with marble, is intended for the two persons who have charge of the light during the night. It is furnished with windows and the requisite conveniencies for containing a supply of lamps, funnels, wicks, oil, &c., &c., having a staircase of mahogany, with a balustrade, attached to the wall. The breadth of this stairway is 24 inches; the steps are a foot high and eight inches broad in the middle; it leads, through an opening left in the arch, to the platform, or upper part of the lower edifice.

Upon this platform is erected a second structure, consisting of a circular wall of hewn stone, 2½ feet thick, eight feet high, and 11 feet 7 inches in its interior diameter. The latter dimensions are determined by the base and diameter of the lantern, which, as has been before said, rests upon it. In this second part of the tower there is a door six feet high by 27 inches wide, to admit of egress to the platform, or corridor, above the cornice. In the floor of the apartment within the upper edifice, which is called the lantern room, and which is also lined with marble, there are two apertures; one in the centre, which is circular and 12 inches in diameter, into which is introduced the foot or support of the apparatus; the other is a foot and a half long by two inches wide, for the passage of the cord to which the moving weight is suspended. This weight is raised by means of a pulley placed in the arched ceiling of the attendants' room, and is enclosed in a case 13 inches square and 12 yards long, formed in the thickness of the wall of the lower part of the tower.

The total height of the tower is, therefore, 87 feet, which, added to the elevation of its base above the level of the sea, 65½ feet, and to the height of the light within the lantern, 5½ feet, will make the total elevation of the light, 158 feet; the horizontal tangent of which is 13½ marine miles. This exceeds, by 16 feet, the height desired in the report of the Marine department, and the light is consequently visible about a mile further than the distance required by them.

Description of the Apparatus for Lighting.—In order to give a

clear and connected idea of this, we shall omit a detailed account of the numerous parts of which the various portions of this complicated machinery consist; and shall proceed to describe only such of them as will serve to make the mechanism understood, even by those who are not entirely familiar with the mechanical and optical principles upon which it is constructed.

The new apparatus for lighting consists of four distinct parts, as follow:—

1. The mechanical lamp.
2. The system of prismatic lenses and reflectors placed around the light.
3. The machine which gives a uniform rotary movement to the prismatic lenses.
4. The glass lantern which covers the whole, without obscuring the light.

The Mechanical Lamp.—This lamp, placed in the centre of the lenses and reflectors, is supported by a hollow pillar of bronze, seven feet two inches high, having, below, a receptacle for the oil, and a set of pumps for raising it. These pumps are worked by machinery similar to that of a clock, the moving weight being contained within the pillar, and are capable of raising four times the quantity of oil which the burners require; from which it follows not only that the flame is maintained with all possible brilliancy, but also that the superfluous oil which flows over the exterior surface of the tubes, and falls back into the cistern, cools the points of the tubes, which might otherwise be fused by the intensity of the heat. In order to increase the watchfulness of those who have the care of the light, it is furnished with alarm bells. The escapement of this machinery is connected with one end of a lever, and at the other, is suspended a vase with a small hole in the bottom. This vessel is so placed as to receive the superfluous oil from the burners, and while full, it sustains the counterpoise; but as soon as it begins to vary, on account of a deficiency of oil, the lever loosens the movement of the alarm apparatus, which gives notice of the irregularity. A first class light has three lamps, so that if one of them shall be out of order, there are still two fit for use in good condition, and the light is constantly maintained. The Havana light has four.

The Prismatic Lenses and Reflecting Mirrors.—The lenses and reflectors, the object of which is to concentrate the rays of light which proceed from the burners of the lamp, in order to give them a horizontal direction, are placed in a metallic frame conveniently arranged, and which, as well as the lamp, rests upon the capital of the bronze column. One part of this frame, which contains the reflectors, is stationary; while the other, containing the prismatic lenses, revolves around the lamp with a uniform motion. This revolution of the lenses causes eclipses of the light, according to the different positions which they successively occupy around the burner, producing a more intense and lively brilliancy in the direction towards which the focus of each lens happens to be directed, continuing thirty seconds before it is replaced by the next; though, on account of the stationary por-

tion of the apparatus which contains the reflectors, there is always afforded, in all directions, a less brilliant light, but one which is still sufficient to enable the lighthouse to be kept in sight.

The Machinery which gives motion to the Prismatic Lenses.—The mechanism of this is like that of a clock, and is placed at the side of the bronze pillar which supports the lamp. A pinion wheel, gearing into another connected with the movable portion of the apparatus, puts it in motion by the action of a weight suspended to a cord passing through the floor of the room which contains the machinery, and descending below into a case made in the wall of the tower.

The Lantern.—The glass lantern, which encloses the light, rests upon the circular wall built above the cornice of the tower, and has the figure of a prism of sixteen sides. It is covered by a cupola of copper, with a chimney in its top to carry off the gases proceeding from the combustion; the whole being surmounted by a weathercock.

By the foregoing description, it will be perceived that this lighthouse, when illuminated, presents constantly a steady light, uniformly alternating, every six seconds, with brilliant flashes, by which it may be distinguished from any other light.

The intensity of the steady light is equal to that given by 550 burners like those of the ordinary Carcel lamp, which consume 3¼ ounces of oil per hour, and it may be easily seen at a distance of six or seven marine leagues. The brightness of the flashes is nearly four times as great as that of the steady light, and equal to that given by 2000 of the above-mentioned Carcel burners.

Data for determining the proper thickness for the Wall of the Tower.—The most interesting and nice question which first presents itself, in considering the construction of a very high tower, is to determine the thickness which its walls ought to have in order to insure the necessary stability, and to resist successfully the forces which have a tendency to destroy it. This is a general principle in all kinds of edifices; but in high towers, the base of which bears a small proportion to their height, it is necessary to consider another element of destruction, more powerful and active than the force of gravitation: namely, the violence of the wind in those great hurricanes which are so frequent on sea-coasts, and particularly among the Antilles.

In the calculation of this force, as in all physico-mathematical questions, the data are, for the most part, derived from experiments, of the accuracy of which we cannot be precisely certain; but which have been found sufficiently worthy of confidence when applied to similar structures which have, for many years, resisted every kind of force; and in this case there is nothing more logical, or natural, than to take the result of these calculations as established data of comparison with reference to our own case.

The data upon which we should reckon in calculations of this kind, founded upon numerous experiments, are as follow:—*First*, The pressure upon a superficial metre, when the wind has a velocity of 50 metres per second, which is that of the greatest hurricanes, is equal to the weight of 275 kilogrammes, or about 386 pounds to the square yard. *Second*, The action of the wind upon a vertical cylinder is

reduced to two-thirds of the force which it exerts upon a central vertical section of the same cylinder.

To apply these rules to the stability of a tower composed of a single stone in the form of a right prism with a square base, we should multiply the superficial area of one of its sides by 386 pounds; and this product being multiplied by half the height of the prism, will give the momentum of the wind's force. In order to determine the momentum of resistance, the total weight of the tower should be multiplied by half the width of its base. Dividing this product by the first obtained momentum of the wind, we have the expression of the *absolute stability* of the edifice with regard to the action of hurricanes.

Towers are composed of numerous courses of cut stone, the adhesion of which affects the stability in proportion to the decrease in the size of the blocks of stone used. If we suppose this adhesion to be nothing in a wall composed of courses of stretchers and ties, the fracture caused by the force of the wind will not be horizontal; but (as in retaining walls) according to an oblique section, the inclination of which is determined by the maximum of relation between the force of the wind and the momentum of weight of the solid above the section. But it should be observed that in most high towers, the adhesion of the cement and the arrangement of the materials is such that the section of rupture is less inclined than in ordinary containing walls, and if, in addition to this, we also consider that the results which we seek are of comparison between our tower and those whose stability has been already tested by having for a long time resisted, without injury, every kind of force; the supposition that the section of fracture would be horizontal should have no sensible influence.

The determination of the section of most easy fracture offers a problem of minimums, the direct solution of which, in general, requires very tedious calculations; but fortunately the position of that section is apparent, in most cases, at the first glance of the eye, or may readily be determined by a few trials.

In case the tower should have the form of a truncated cone, like that of which we are treating, if it should ever yield to the force of the wind, it would be twisted off above the offset of its base, in the direction opposite to that from which it receives the force, and its being broken above the offset would be because the arm of the lever of resistance, instead of being equal to the radius of the section of rupture, is somewhat less.

These principles being established, it is known that, in order to give great stability to a circular wall in ordinary structures, it is sufficient to make the thickness a twelfth part of the height; consequently, having to raise our tower to a height of eighty feet, a thickness of seven feet was enough for the wall; but as the tower is not an insulated wall, but has within it, a circular stairway which binds and fastens together all its parts, and, moreover, as the consideration of a convenient situation for the illuminating apparatus required that the upper part of the tower should be only 20 feet in diameter, we were able to start with seven feet at the base, and to diminish gradually to

four and a half at the top, with the advantage of an exterior slope of two and a half feet in the whole height, which also adds to its strength.

Having established these data, it now remains to examine whether, with these dimensions, the tower possesses as much, or greater, strength than others similar to it, which have been built many years, and have resisted, without the least damage, the force of the greatest storms, and I say it ought to be stronger: 1st, Because the terms of the comparison which we seek are derived from towers built in Europe, where hurricanes are neither so frequent nor of such long duration as in the Antilles; and, 2nd, Because the tower which we have constructed, from its peculiar situation, has to sustain not only the force of the wind but the shock of the waves, although this is somewhat diminished by the tower's being placed 22 yards above the level of the sea.

For comparison, we will take the signal tower erected in 1715, at the port of L'Orient, the form of which is similar, on the whole, to that constructed at the Moro, and which has withstood until the present time, without injury, all the force of the storms.

Stability of the Tower at L'Orient.—The result of a calculation with regard to this tower shows that the relation of the resistance to the pressure is 7·4; that is to say, the resistance is 7·4 times greater than the pressure. Let us now see what result will be obtained by an analogous calculation with regard to the tower at the Moro.

Calculation of the Stability of the Tower at the Moro.—The content of the truncated cone which constitutes the lower part, is 31,174 cubic feet. The interior cylinder, which contains the staircase, is 11 feet in diameter and 34½ in circumference; the area of its base, 95 square feet; and its content, 95 × 78 = 7410 cubic feet. Taking this from the total solid content, there remain 23,764 cubic feet for the solid content of the circular wall of the lower part of the tower. The cylindrical column in the centre of the circular stairway contains 450 cubic feet, and the stairway itself 306; so that the total solidity of the masonry in the lower body of the tower is 24,520 cubic feet, or 908 cubic yards. Adding to this three cubic yards for the projection of the cornice, and subtracting 36 yards for the apertures left for doors and windows, there remain 875 cubic yards of masonry. As the attendants' room, in the lower section of the tower, is a foot larger in diameter than the interior space occupied by the stairway, it follows that the amount of masonry, which on this account has been rather over-estimated, will be made up by the arched ceiling of this room, which has not been taken into the account.

The solid content of the circular wall which forms the upper section of the tower, upon which the lantern is placed, is 27 cubic yards, deducting the opening for the door; so that the whole amount of solid masonry is 902 cubic yards.

A cubic yard of the masonry used in this tower weighs 85 arrobas, (25 pounds each,) and the arm of the lever of resistance being four yards, (a little less than the radius of the base,) it follows that the power of the resistance will be 902 × 4 × 85 = 306,680.

A central perpendicular section of the lower portion of the tower

contains 195 square yards; of the upper portion, 13; and of the lantern, 26; presenting a total sectional superficies of 234 square yards. The centre of gravity of these three superficies is found at 13 yards from the base of the tower; consequently, the momentum of pressure from the wind, is $\frac{2}{3}$ 386 × 234 × 13 = 31,504 arrobas, and the ratio of the resistance to the pressure $= \frac{306,680}{31,504} = 9{\cdot}7$.

By this result it will be seen that the tower at the Moro has a stability equal to nearly one and a half times that of the tower at L'Orient, which was taken for comparison, and consequently that its dimensions are sufficient, although indispensable for the reasons already mentioned, to warrant the undertaking of its construction with entire confidence.

Details of the Construction.—Foundation. As the tower is 25 feet in diameter at its base, a circle 28½ feet in diameter was traced around the centre of the area to be occupied by it; so that the excavation for the foundation being larger than the body of the tower, a berm, or offset, of 21 inches, would be left by the extension of the foundation wall beyond that of the tower itself. The excavation was carried through the surface soil down to the rock which underlies the glacis of the Morillo, which was reached and laid bare at an average depth of 15 feet.

The rock presented an irregular surface, in consequence of which, together with its extreme hardness, the operation of cutting it down to a level would have been very expensive. It was therefore deemed preferable to construct the foundation by steps, *(en escalones,)* using blocks of stone of the best kind, disposed in circular horizontal layers, *(formando anillos en capas horizontales,)* properly placed, and the joints filled with a mixture of lime and sand; taking care, as in all masonry of hewn stone, that the joints of each layer should be covered by the course immediately above it.

The foundation is 9½ yards in diameter by five in depth, and consequently contains 355 cubic yards of masonry. The cost of its excavation and refilling was 1554 dollars, being 4·375 dollars per cubic yard. In the calculation of the original estimate it was assumed that the foundation would be only three yards in depth; consequently containing 213 cubic yards, of which the cost, estimated at 7·50 dollars per yard for the masonry, including the excavation, amounted to 1597·50 dollars, being an excess of 43·50 dollars.

In calculating this estimate of 7·50 dollars per cubic yard of masonry, it was proposed to use all the materials of the old tower; but as this would not be sufficient it was supposed that the stone still to be provided would have to be purchased and transported from the opposite shore. The great reduction which was made in the cost per cubic yard of this work, from that originally estimated, was owing to the following causes: *First*, Instead of buying from individuals the stones which were required, those were procured which remained unused from the erection of the fortifications at that place, and which had been taken from quarries opened for that purpose; on which ac-

count they were obtained at a much lower price, while, at the same time, the expensive transportation in vessels was avoided. *Second*, Because it was not necessary to purchase sand for making the cement, having used that which was found in the fosses of the fortifications.

The digging of the foundation was commenced on the 17th of August, 1844, and by the 24th of September it was completed and leveled off to nine inches below the glacis of the castle; being then in order for receiving the first layer of stone for the tower. During the same time the old tower was completely taken down, its materials, as has been already said, being used for the new foundation.

The lower part of the Tower.—Upon the level top of the basement, or foundation, the first layer of stone forms a solid floor over the whole, 25 feet in diameter; its outer border being vertical and forming a projection or socle of nine inches around the tower, as well as a step of the same height, for entrance into it. The building is then continued to the requisite elevation by successive courses of 18 inches in height. In order to give an exterior slope to the wall, and consequently to diminish its thickness in due proportion, the width of the blocks in the interior courses was gradually contracted, while those on the exterior were continued of the same breadth, so that the vertical joints might recede gradually towards the interior, and the masonry be well united together; thus avoiding the defect which would result from an equal diminution in the breadth of the blocks used in both the inner and outer faces of the wall, in which case, the vertical joints of each course would continue to be one above another, thus forming two distinct walls, without further connexion than that of the extending ties.

The circular stairway is composed of entire blocks of stone, which are inserted six inches into the wall, each of them forming two steps, together with the corresponding part of the central column, or nave, of the staircase. It was carried up at the same time with the wall of the tower, in order to insure the proper connexion and binding together of the work, and also served for use during the construction of the building; the order of proceeding being first to set the block of stone which formed two steps, and then to lay the corresponding course on the wall, and so on, successively. The nave, or central part of the stairway, is cylindrical throughout its whole height, except at the top, where it increases in diameter, with a view of gaining a certain space on the floor of the attendants' room. In order to give this proper form to the central column, its diameter was gradually enlarged, beginning at the 17th step from the top, and so continuing to the last; so that the stairway is only 27 inches wide in the last six feet of its flight.

The upper part of the Tower.—This is a simple circular wall of cut stone, composed of blocks in alternate order, and presenting nothing worthy of special notice.

Arch of the Attendants' Room.—This arch is in the form of a simple dome, and presents nothing remarkable in its construction. The thickness of the wall which supports it is that which is strictly necessary for the equilibrium, since the excess in the weight of its ma-

sonry, from the spring of the arch to the key, and that of the upper part of the tower, which also contributes to its stability, are more than sufficient to compensate for the weight of the apparatus for illumination, which rests upon the summit of the arch. But notwithstanding this, as the three openings in it somewhat diminish its strength, the precaution was taken, in order to avoid the least displacement, to fasten all the arch stones of the second and third courses, together with those of the first,, with iron clamps, one and a half inches thick by three inches wide, let into the arch stones and fastened to each of them by a bolt, which passes through two-thirds of their thickness, well secured with lead.

Materials.—The stone used in the construction of the tower was taken from the quarries known here by the name of *playa de chivos*, immediately at the point where the tower stands, and preferable to the stone found at any other place in the vicinity, because, although not of the hardest quality, they are still sufficiently so, and of a more equal and homogeneous texture than the others. Great care was also taken to use blocks of the most durable kind in the exterior surface of the wall, and for the steps of the stairway.

The lime and sand employed were both of excellent quality; the former made of a very hard and clean stone, and the latter containing no saline matter. The mortar was made with great care, composed of two-fifths of lime and three-fifths of sand, mixed with fresh water and well stirred, so as perfectly to incorporate the ingredients.

The doors, windows, interior balustrades, and hand rails of the staircase are of mahogany.

After the completion of the edifice, in order to preserve it from the effects of moisture and of nitrous salts, inasmuch as the stone, as already stated, is not of the hardest kind, it was covered, both on the interior and exterior surface, with a very thin and well laid coat of painted stucco.

The cost of the whole structure, when completed, was very nearly that calculated in the original estimate.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On Balances. *By* Franklin Peale, Chief Coiner of the Mint of the United States.

(With two Plates.)

In order to insure precision and regularity, to obtain facility and rapidity, and, above all, to avoid liability to error, it has been found necessary to combine, in the balances used in the mint, not only all the arrangements known to us that have heretofore been found important, but also such improvements as have been the growth of our own experience.

The result has been satisfactory, in a remarkable degree; so much so, as to be a subject of surprise to the most experienced of the corps of officers of this establishment.

In the present communication, no attempts will be made to establish claims of invention, either for ourselves or others. In fact, it would be impossible to do so with justice. Balances of every variety of structure have long been made, and may be readily met with; and all that we can now claim is, after much experience in their use, to have combined their best parts, and, in doing so, to have introduced such modifications and adaptations as have been found desirable.

In the balances, of which this notice treats, two considerations have claimed particular attention: the first is precision, the second construction.

Under the former head, a descriptive notice will embrace remarks on such provisions and operations as are deemed important; and under the latter, a description of construction, illustrated by engravings of the balance as erected, and of the separate parts in detail.

To obtain the greatest degree of uniform precision, it is requisite that the beam should be lifted, from a state of rest, in a perfectly level position, and that the stirrups should be lifted, simultaneously, with their loads, from their rests, or supports; also that the oscillations of the stirrups should be prevented or checked at the earliest moment; and, finally, that the whole system should be left at liberty with delicacy and exactitude, so as to remain in equilibrium, or vibrate, as the case may be.

To command the above conditions, the beam should be supported upon cones, at each extremity, adjusted level with each other, from which it is lifted, by a plane which rises under its centre knife-edge, and to which it is returned by its depression, the cones guiding the beam to the same position exactly from which it was elevated.

The stirrups, in like manner, should hang upon hollow cones or V's, so as to be taken up from, and returned, invariably, to the same position.

The support for the centre knife-edge, as well as the hangers which rest upon the knife-edges at the extremities of the beam, should be planes, and not portions of hollow cylinders, as is usual.

The beam should rest upon its cones, and the stirrups should be supported by their V's at such heights as to relieve entirely the knife-edges, with a sufficient space between them and their respective planes to permit inspection and wiping, when it may be needed. This construction admits of the placing of the weights, &c., and guards the knife-edges from the consequences of displacement during use.

The beam should be raised by the elevation of the centre plane, subsequently lifting with it the stirrups with their weights and load, and all oscillation checked by platforms placed in the table under the centre of the stirrups, which should be made to rise simultaneously, and should be counter-weighted to the requisite delicacy.

The descent of these platforms, effected by the pressure of a finger on a lever conveniently placed, will leave the stirrups, &c., at liberty to vibrate, or bring the beam to a horizontal position, at the will of the operator; being a convenient, certain, and rapid method of manipulating, not equalled by any other arrangement, and, in fact, essential to a well-constructed balance.

The knife-edges should be constructed of the best cast steel, hardened to the utmost ability of that metal, and the planes upon which they bear should be made as true and perfect as possible; those for the finer or more elaborately finished beams, should be of agate, or chalcedony.

Having thus concisely stated the essential qualities in balances for accurate and rapid weighing, it will be proper to explain the construction by which these qualities are acquired, being the second branch of this essay. In explanation of this, reference is now made to engravings which accompany this notice: one, exhibiting a front view of the whole; the other, the parts separate and in detail.

Description of the Plates, with Explanatory and General Remarks.

Plate I represents a front view of the balance drawn on a scale corresponding to a beam four feet in length, suited, in its proportions, to weigh one thousand dollars in silver. The weight to which it is limited should not exceed one thousand ounces troy.

A beam of three feet in length is suited to drafts of five thousand dollars in gold coin, and the maximum weight should not exceed, in any case, three hundred ounces troy.

The proportions exhibited in these plates may be maintained throughout for the above sizes, or any other, either greater or less, than those which are stated.

A table, marked A, is furnished with leveling screws upon the front and back edge, and at each end, marked *b*. In plate II, which exhibits different views of all the parts, the leveling screws are marked *b*, and their positions in the table (the view of the under side of which is given) are marked *c*.

The balance is intended to be placed upon a counter, or any other firm support, and the table leveled by means of the screws last described, its true position being indicated by a plumb-line and weight occupying the rear opening in the column; (plate I, fig. *c*;) the plumb-line and weight being marked *d*.

The column, marked C, in plates I and II, contains the lifting apparatus, and supports the cap-plate, marked D, plates I and II. The cap-plate guides the lifting apparatus, and supports the V's, or hollow cones, for the stirrups, and is strengthened and stayed by braces, marked E; the section of which braces is cruciform, with circular ends, for firm bearing upon the plate and base of the column, to which they are secured by screws.

Plate II exhibits upper and under views of the table, column, plate, &c., also upper and lower end views of the column, showing the means of its attachment to the table and cap-plate.

Balances intended for service alone may be made of cast iron, exclusive of the beam For small balances, or when higher finish and display is designed, bronze, or ordinary brass, may be used.

The lifting apparatus consists of a winch-handle, marked *f*, plate

II, fitting upon a round shaft, *g*, with a feather, so as to admit of its convenient removal; upon this shaft is fitted a cam, *h*, also secured by a feather; the cam is carefully constructed, so as to give equal elevation to equal parts of its revolution; and upon the cam rests a roller, *i*, which turns upon a pin in the frame, *j*, intended to reduce friction, and give facility in raising the beam with its load.

The lifting frame, *j*, is forked cross-wise, so as to straddle the shaft and accommodate the cam and roller, at the same time that it allows the necessary vertical motion, without the possibility of being displaced; all of which is exhibited in the two views of the lifting frame marked *j*, which is also accompanied by sections in proximity to the parts which they are intended to explain.

The handle is so placed as to be on the left when the beam is down and at rest, and to the right when the beam is raised, in the act of weighing, and makes, together with the cam, more than three-fourths of a revolution, the cam having a very slight depression upon its upper, or highest point, into which the roller falls, maintaining it in its position when the beam is raised. It is then extended beyond the centre of the roller, so as to be stopped at the limit of motion, as exhibited in fig. *h*, plate II.

The lifting frame is forked at the top for the accommodation of the beam. Upon it rests the plane, the top and side view of which are marked *k*, for the support of the centre knife-edge, secured to the frame by screws. In balances of ordinary construction, this plane may be made of hardened cast-steel; in finer instruments, of bronze, or brass, with an inserted block of polished agate, secured by fusible metal, or cement.

The position of the handle, lifting frame, &c., are exhibited with sufficient clearness in the front view, plate I.

The cap-plate, views of the upper and under sides of which are given in plate II, fig. D, is constructed with horizontal spaces at the centre and each end. In the middle it is secured to the column by four screws, and to the braces B in the same manner, the holes for which are marked in all the views.

The square opening in the middle serves as a guide and support to the lifting frame, which must be accurately fitted, so as to prevent any lateral play.

The horizontal spaces at the extremity of the cap-plate support short pillars terminated by cones, upon which the beam rests; these pillars are secured to the cap-plate by screws passing through it from the under side, the holes through which they pass being large enough to admit of the adjustment of the beam to its proper place, previous to their being permanently fastened down.

The details of these pillars are given in plate II, fig. *l*, the cones being constructed of cast steel, hardened and polished.

The same space also supports the V's, or guide supports of the hangers, different explanatory views of which are given in plate II, the V's being marked *m*, and the hangers *n*. All these parts have been devised with reference to the simplest and most economical con-

struction consistent with the requisite accuracy, and for affording the greatest facility in the final adjustment of the balance.

The most important part of the balance is the beam, the form and material of which, both with reference to use and construction, have been carefully considered. Plate II, fig. *o*, exhibits side and top views. It will be observed that the beam is perfectly simple in its form, thickened at the centre and extremities, for the security of the knife-edges, the arms being diminished, in depth, regularly, from the middle to the extremities, a section in any part of which would represent a sharp wedge, with its extremities rounded, as shown by the dotted lines at *p*, the thicker being the upper edge of the beam. The projections marked *q*, are the supports of the beam when at rest; the conical cavities, indicated by dotted lines, being made to fit the cones marked *l*.

This form of beam affords facility in construction, being composed of straight surfaces, without ribs, or curves; is well adapted to maintain its form when loaded; affords the least surface for accumulation of dust, and is readily wiped when it may be necessary. The means of adjustment for the length of arm is exhibited in fig. *r*, plate II.

As a general rule, convenient and accessible means of adjustment are to be deprecated. Balances should be constructed with reference to the use to which they are destined, and the necessary accuracy and sensibility given in construction. It will be found, it is believed, more inconvenient than desirable, to attempt to change the sensibility of a beam devoted to different uses. Again, a person might have sufficient mechanical skill to use a balance and weigh accurately whilst it is in order, who would be much embarrassed by the consequences of a change in the centre of gravity, affecting the accuracy and sensibility respectively, without consciousness of the cause, or knowledge of the effects. A repetition of the remark, that prominent and accessible means of adjustment are to be deprecated, will be excused, as having a tendency to invite to attempts at adjustment by the incompetent and unskilful, or it may be to derangement, by the meddlesome.

The material best suited to the construction of beams will depend upon the purposes to which they are destined. For mint usage they should be of rolled brass, or a malleable alloy of copper and tin, well hardened by heavy hammering. The difficulty of procuring castings perfectly sound, and free from "blows" being a sufficient reason for the rejection of cast metal of any kind.

It will be seen, that the needle of the balance, which is the subject of description, is pointed downwards, and there are good reasons for this disposition. In the first place it is directly before the eye of the operator, and therefore more convenient in use, than it is, when elevated above; again it may be made longer than the arms of the beam, and will consequently describe a larger arc, and thus give more distinct indications, whilst the whole arrangement need occupy no more space than is requisite for the other parts; and finally, the needle is protected from external injury by the lifting-frame and column, in the centre of which it is placed.

The parts which remain to be described have been usually consi-

dered of minor importance, but experience has shown that this estimate is scarcely a just one, inasmuch as they afford facilities for accuracy and rapidity, that leave no doubt of their value, and place them in a most important position in practice. The parts now alluded to, constitute the system by which the operator is enabled to find the equilibrium of which he is in search. It consists of the pedestals, as they have been termed, marked *s*, plates I, and II, and the parts connected with them, marked *t*, *u*, *v*, and *w*, in plate II; a light shaft, made of tubular iron, *t*, supported by pivots *u*, which pivots are screwed through a piece cast on the under side of the table, marked V; upon the ends of this shaft there are levers, W, upon the ends of which levers, when in place, the pedestals rest.

The remaining part of this system is a double armed lever, placed in the middle of the shaft, *t*, (represented in the engraving detached,) and marked *x*; it is connected by a pin, with the trigger, *z*, represented in its place in plate I, with the same letter. Upon the other end of the lever, *x*, there is a weight, *y*, capable of adjustment by a screw upon which it traverses, so as to be approached to, or receded from the shaft, *t*.

The action of this system is easily understood, its whole object is to depress the platforms by sufficient force, applied by the finger, to the trigger, the counter weight returning them to their original position, after its removal.

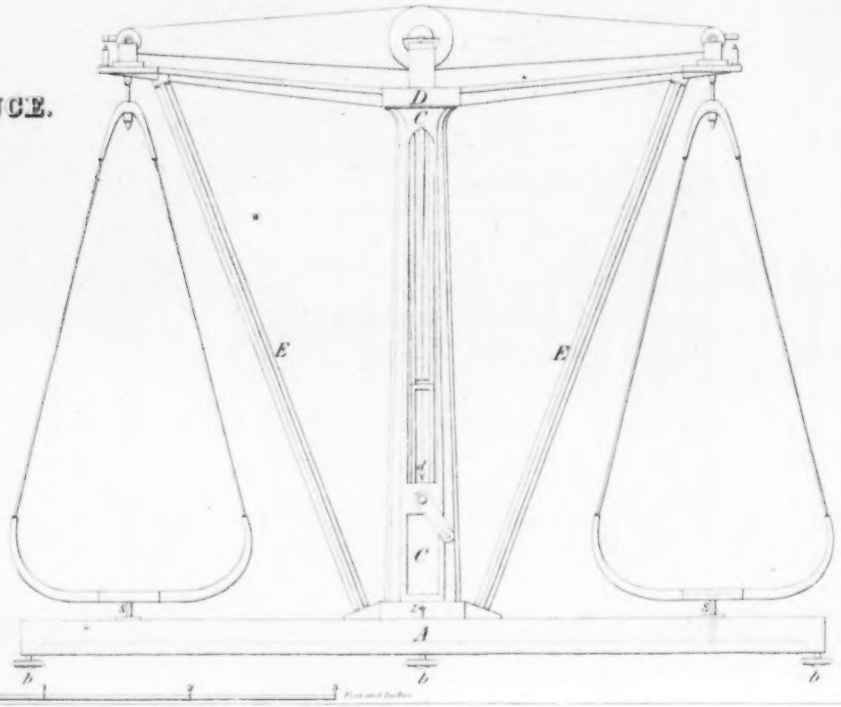
It will be seen, by reference to plate I, that the under sides of the stirrups have a space, represented by dotted lines, in which the platforms are placed, which allows the stirrups to oscillate within its limits, but beyond which they cannot move. This construction is intended to guard the hangers from displacement, and to prevent injury by too much movement of the stirrups, an accident very likely to occur, when the pans or weights are hastily removed, especially in the use of the larger balances with heavy weights or large masses.

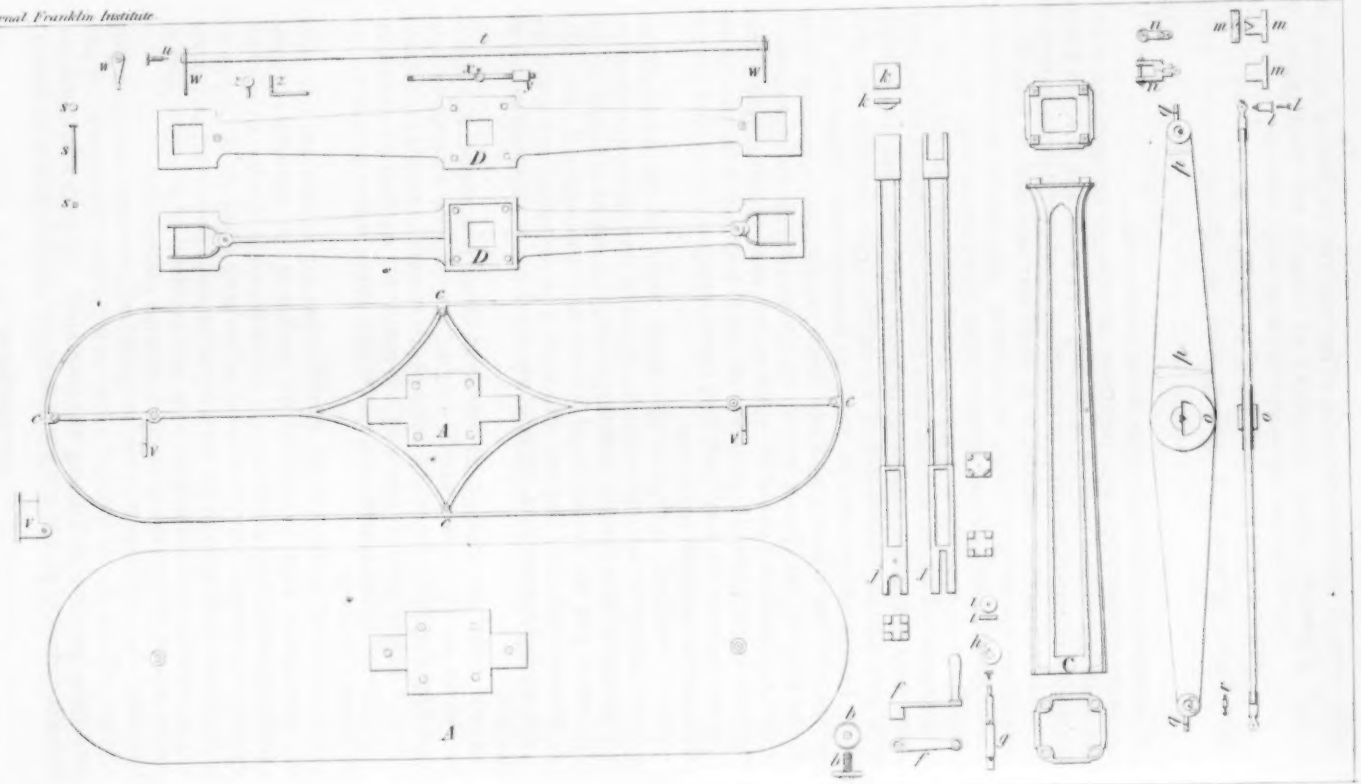
The cavity, whose object was described in the last paragraph, forming the under side of the base of the stirrups, is turned as truly as possible in the form of a portion of a sphere, whose radius is its distance from the bearing of the knife-edge. The platforms are adjusted by means of the counter weight, so as to press lightly up against the stirrups, and to follow them when raised.

It is found convenient in practice to turn the handle of the balance but a small portion of its movement, if the weights are not equal on opposite sides, a circumstance to be expected when searching for a weight. The heavy side will remain down, and the needle will indicate whether addition of weight, or its removal is requisite. These trials are continued until the platforms follow up the whole lift, the needle remaining opposite the middle line of its scale, until the handle is stopped by its limit of motion, where it remains. The finger, then, by pushing down the trigger, will depress the platforms, when smaller weights are employed until the needle indicates equilibrium.

In this balance there is little or no embarrassment from oscillation, because the stirrups immediately accommodate themselves to the position of the weights, the light pressure permitting them to take any

PEALE'S BALANCE.




D
D
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position required by the load; nevertheless, having sufficient power, from their pressure, to prevent any swinging. If from any cause the stirrups should be in motion, three consecutive depressions of the platforms, will bring them to a state of rest, with absolute certainty, and with a loss of time so short as to be entirely immaterial.

The stirrups are connected with the hangers, by a rod, which is double-jointed, as near to the hangers as possible, so as to allow perfect freedom of motion; at the same time, so well fitted as to allow no change of position in the parts. On the lower ends of these rods, there are screws and nuts, to regulate the height of the stirrups, together with a jam nut, to prevent any change after the adjustment has been satisfactorily made.

The bases of the stirrups are designedly made small, requiring the use of a dish on the one side, and a platform for weights on the other. This dish and platform being made of equal weight, renders the use of a counter weight unnecessary, and as the balance cannot be used without both, the liability to mistakes from this cause is entirely avoided.

For the adjustment of weights, or any other use of balances requiring the greatest degree of delicacy and care, it is necessary to protect the instrument and the operation, by a case, with doors sliding vertically, and glazed, so as to permit inspection, undisturbed by currents of air. This arrangement, entirely essential for such uses, is inadmissible for ordinary weighing, involving too much delay in the necessity for opening and shutting the doors.

In the balance for weighing gold coins, which was placed in the exhibition of the Franklin Institute, in 1846, and which is now in use in the weighing and counting room of the chief coiner's department in the mint of the United States, all the parts, with the exception of the stirrups, are covered by plate glass, inserted into the framing, so as to protect the balance as much as possible from currents of air, dust, and external influences of all kinds. This balance has been made with the utmost care in all respects, upon the principles detailed in the foregoing notice, and the result has been satisfactory in the highest degree. In illustration of which, it may be stated, that with its maximum load of six hundred ounces, three hundred on each side, it is sensible to the ten-thousandth of an ounce. This fact is not mentioned as very remarkable, because it is comparatively easy to give great sensibility to balances: but it is worthy of note, that it is invariable in showing this minute fraction of its load. As regularity is of the greatest value in operations with balances, we may be excused for drawing attention to a quality of so much importance.

Descriptive Memoir of a New Process for Manufacturing White Lead, or Carbonate of Lead, invented by M. Gannal.

TRANSLATED FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

The difficulties which are known to exist in the manufacture of white lead by the processes now in use, and the dangers to which the

workmen employed in it are exposed, determined me to undertake a series of experiments, in order to discover a process more simple and without danger to the workmen.

I feel truly happy in being able to announce to the Academy that I have succeeded in my attempts. *By a process extremely simple, in a very short time, without any danger*, I manufacture any quantity of white lead that commerce may require, and my product will bear comparison with the most perfect that is made.

Among the chemical and mechanical processes thus far known, for the manufacture of white lead, not one appeared to me to combine the conditions necessary to obtain this product with economy and without great danger to the workmen.

A patent, taken out in 1834 by Mr. Walker Wood, points out a method, some parts of which, indeed, seem to be new; but the descriptions of this patent are so obscure, and at the same time so erroneous, that I have not thought it worth while to dwell on it.

The following is the description of the manner of proceeding, by which I arrived at a good result:

A hexagonal or octagonal leaden cylinder is to be prepared, two metres in length, with a diameter of from thirty to forty centimetres. The lead should be from five to eight millimetres in thickness. This cylinder is to be enclosed in a frame made of rod-iron; to one end of which a crank is to be attached. It is to be placed on a stand, so as to receive with ease a rotary movement.

At the centre of the cylinder there is to be an opening or bung-hole through which the materials are to be introduced. At the end opposite the crank and in the axis of the cylinder, another opening is to be made, of from three to four centimetres in diameter, through which is to pass, without closing or stopping it up, an elastic tube fitted to a bellows. This tube must reach the bottom of the cylinder.

100 kilogrammes of granulated lead and thirty litres of water are to be introduced into the cylinder; the bung-hole is to be closed, and the apparatus is ready to operate. In this state, if the lateral opening is closed and the apparatus turned round at the rate of forty-five or fifty turns per minute, and if this motion is continued for five hours, about two thirds of the lead will be found reduced to an impalpable powder and still retaining its metallic color.

If the lateral opening remains open, then the lead so divided becomes oxidated, and the product taken out is a protoxide, or massicot, hydrated in part.

Lastly, if an elastic tube reaching to the bottom of the cylinder is fitted to the apparatus, the other end of which is attached to a bellows receiving air from a close chamber or enclosure in which there is burning charcoal; the finely divided lead coming in contact with the air and the carbonic acid blown into the apparatus by means of the bellows, is converted into oxide, and finally into carbonate of lead or white-lead.

Acting on this principle, we manufactured a considerable quantity of a product, which was judged to be equal in quality to the best of that met with in commerce.

When the cylinder has been turned for a sufficient length of time, the bung is to be opened, and the liquid contained suffered to run out; a quantity of water equal to that first introduced, is put in, the cylinder is to be turned for five minutes, this second portion of liquid is to be run off, then the apparatus may be immediately re-charged for a second operation, introducing, however, only seventy-five kil. of lead, inasmuch as there remain twenty-five to thirty kil. not finely divided.

In order to facilitate, and hasten the operation, we have made use of two different processes. The first consists in pouring into the water, at the moment of charging the apparatus, five hundred grammes of nitric acid. The second in substituting for the acid one kil. of nitrate of lead.

It is, however, to be remarked, that during the operation a little nitrous acid is disengaged, and that when the operation is completed, scarcely any is to be found in the mixture that remains. I have observed that the acid or the salt of lead is decomposed. A subhyponitrite is doubtless formed, which is afterwards decomposed by the carbonic acid.

The liquid product, withdrawn from the cylinder, is poured into a vessel containing eight or ten times the proportion of water made use of in the operation. This mixture, violently agitated, becomes considerably whiter, in proportion to the blue tint of the product taken out of the cylinder, which is occasioned by a quantity of lead, finely divided, but not yet oxidated, or yellowish, if formed of oxide not carbonated.

It is to be observed, that after two days washing, the whole of the product is of the most dazzling whiteness. However, I would here observe, that having dried immediately some white-lead which still contained about one-eighth of its weight of divided and non-oxidated lead, at the end of two months the entire mass had a homogeneous tint.

As in this operation some portions of granulated, and others of imperfectly divided lead, escape from the apparatus, it is necessary to let them deposit in vessels having openings at different heights. In the first place the clear water which floats above the deposit is drawn off, then by an opening somewhat lower down, the pasty deposit, which rests on the imperfectly divided particles of lead.

The pasty mass is thrown on filters of closely woven cloth, which have been previously fixed on frames. Here a large quantity of water drains off and leaves a plastic residuum. In this state, the filters are taken down, the ends of the cloth are folded over, and the whole is subjected to a violent pressure.

When this pressure has removed the greatest quantity of water possible, the packets are taken out, the cloths are taken off, the mass is divided into pieces of the desired form, and they are then placed in a hot air stove.

As may be seen, the theory of this operation is as simple as its manipulation. In adopting this system of manufacture, we have *simplification of labor, a larger product, saving of manual labor, and less chance of loss.*

Until the present period, our manufacturers, followers of blind routine, imitated the form which the Hollanders formerly gave to this article; but now, our workmen, our foremen are too well informed to pay any attention to the particular form or shape that may be given to a product. And when they learn that the adoption of this new form or shape has for its principal object the preservation of the health and life of many thousands of fathers of families, who annually perish in consequence of the fatal results of the present mode of manufacture, they will doubtless applaud the intention of my publication, and will hasten to call for white lead in a new form.

To sum up the whole, my process of manufacture consists:—

1st. In granulating the lead.

2d. In reducing it into indefinitely fine particles by friction on itself in a leaden cylinder.

3d. In facilitating the oxidation of the lead so divided by the introduction of atmospheric air into the apparatus.

4th. In *carbonating* immediately this oxide of lead by making use of air more charged with carbonic acid.

5th. In hastening the oxidation of the lead, by introducing into the apparatus nitric acid or the nitrate of lead.

6th. In washing the product obtained by this process.

7th. In hastening its desiccation, by subjecting the result to the greatest possible pressure.

8th. In dividing by square points the pressed mass.

9th. In drying in a hot-air stove the divided product.

On the 24th of December, 1839, a room and the closet of an apartment still occupied by M. Mequignon, Jr., rue des Grands Augustins, No. 9, were painted by Mr. Coulon with white lead manufactured by me by this process; this paint, after four years, is as beautiful as when it was first applied.

The publication now made is entirely for the benefit of the workmen. The manufacturers will hasten to adopt it; but I think, moreover, that taking into view public health, the government ought immediately to interdict the method of making it by putting the lead into pots, which is the principal source of the painters', or lead cholic.

Note—1 metre = 39·37 inches; 1 centimetre = ·3937 do.; 1 millimetre = ·0397; 1 kilogramme = 15434 grains; 1 litre = about 1 quart.

We take pleasure in inserting in the Journal the following interesting letter from Edward Miller, Esq., one of the engineers of the Pennsylvania Railroad Company, giving an account of a recent explosion of a locomotive engine upon the Allegheny Portage Railroad; and we hope that when others may have opportunities of ascertaining the circumstances attending the explosion of steam boilers, they will forward an account of the facts to the Franklin Institute.

COM. PUB.

Explosion of the Locomotive Engine "Bush Hill," on the Portage Railroad.

JOHN C. CRESSON, ESQ.,

Chairman of Committee on Science and the Arts, Franklin Institute.

Dear Sir,—Upon the day I passed over the Allegheny Portage Railroad, April 23rd, 1847, one of the locomotive engines attached to a freight train exploded, killing the engine driver and injuring severely two other persons. I could not, at the time, obtain a correct statement of the facts, as business required me to proceed the same night to Pittsburg. Being at Johnstown on the 4th inst., I had an opportunity of examining the wreck and inquiring into the facts connected with the explosion, which I now send you, to be laid before your committee, if you consider them of sufficient importance.

The locomotive "Bush Hill" was built by Messrs. Norris, and put on the Columbia Railroad, April 17th, 1837. In the fall of the same year it was transferred to the Portage, where it has since been in constant use. It was a six-wheeled engine, weighing 12 tons, being one of the heaviest on the road, used the adhesion of two wheels, and was considered one of the best machines on the Portage. It was generally used as a freight engine, but had been running on the 13 mile level for some some days prior to the morning of the accident, with the passenger train.

On that day, the steam was raised by the fireman before breakfast, with the expectation that the Bush Hill would have to take the passenger train; but the regular passenger engine, which had been undergoing repairs in the Johnstown shops, arrived, and took its place. But for this change, the loss of life might have been much greater.

The fireman, John B. Davis, states that he tried the gauge-cocks before going to his breakfast, and found the water above the upper cock. He also tried them after breakfast, before the engine started, and found a full head of water.

The engineer of the Bush Hill, James Patterson, had gone down to Johnstown the night before, to ask that another person might be sent to run his engine, as he wished to attend a funeral. James Barron was accordingly sent up with him by the passenger line in the morning to incline Plane No. 1; but, as the funeral was to take place at the half way house, it was concluded that Patterson should run the engine that far, Barron accompanying him. The Bush Hill was attached to a freight train, and after proceeding about one quarter of a mile exploded, killing Patterson, and wounding Barron and Davis badly.

The only part of the boiler which gave way was the forward flue-sheet, the upper part of which was torn from the flanch by which it was riveted to the boiler, as far down as the upper row of copper flues, which were also torn loose. The remaining flues, and the whole cylindrical part of the boiler, together with the dome and fire-box, sustained no injury from the explosion. The rent followed strictly the angle of the flanch, without starting a rivet. The rush of steam

forward threw the engine entirely over, and it fell backwards, bending the platform against the dome, and crushing the tender and one of the cars. The working gear was much bent and broken.

The flue-sheet was made of two plates, riveted together; the lower one, through which the flues passed, being of three eighths of an inch iron, and the upper, one-quarter inch. The upper plate was strengthened originally by two stay-bars, both of which were broken off, their fractures shewing that they had given way long before. No signs of want of water, nor of overheating, appeared in the flues, fire-box, or any part of the boiler.

The angle at the flanch of the flue-sheet where the rent occurred, was probably injured originally in the bending, as a very bad flaw extends not only around the fractured part, but also around the portion below the flues, which was not injured by the explosion. I have sent two portions of the flanch, by Mr. Power, to the Institute, from which this will be apparent.

Mr. James Bowstad, the foreman of the Johnstown shops, says, *he noticed last winter that the flue-sheets of several of the locomotives, including the Bush Hill, were sprung*, and he believes that in all these cases, the stay-bars are broken. The other engines which are in this condition are in daily use on the road, and they are unable to repair them, because there are no spare engines to supply their place. He considered the Bush Hill in good order in all other respects. He says that he examined it the day before the accident, in order to ascertain whether a new patch which had been put on the dome leaked. The steam was then high, but it did not leak of any consequence. James Barron states that, when he and Patterson got on the engine, the steam was escaping rapidly from this patch, and he thought it too high, for *it was very blue*. He did not, however, at the time, consider it dangerous. Neither Barron nor Davis knew anything about the condition of the safety-valve, and they have no recollection of hearing the steam blowing off at the valve.

Mr. Power, the Superintendent of the road, believes that the valve was screwed down by somebody while the fireman was at breakfast, during which time, the engine stood on the track, fired up, and waiting for the train, with nobody to look after it. This is, however, mere surmise; the injury to the valve preventing any conclusions as to its condition. The safety-valve was two inches in diameter, and the scale of the spring-balance would not indicate a greater pressure than 130 pounds to the square inch if screwed down as far as it would go.

In conclusion, I will remark that the cause of this accident is more manifest than in any explosion I have had occasion to investigate. The evident flaw at the flanch of the flue-sheet, and the fracture of the stay-bars rendering an explosion almost inevitable, if any accident or carelessness should produce an unusual head of steam.

What can be said of the policy which compels the use of locomotives in such a condition as this? for there is good reason to believe that several others are in the same dangerous state. The number of these machines on the Portage is entirely insufficient to convey the traffic upon it with economy and safety; all of them have been many

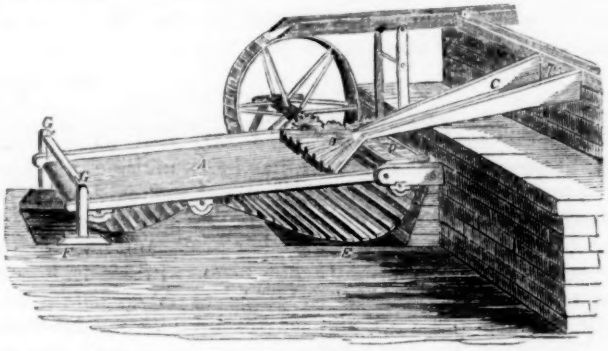
years in use, and many of them are engines which had been used on the Columbia road until antiquated, before being transferred to the Portage.

Very respectfully, EDWARD MILLER, C. E.

Pittsburg, Pa., June 10th, 1847.

Brunton's Ore-dressing Frame.

As much attention is now being paid to the operations of this machine, by which a great saving is effected in the cost of dressing ores, we take this opportunity of giving a description of the process, illustrated by a diagram.



A is a piece of prepared canvas, 30 feet long, joined at the ends—thus forming an endless band, with slips of wood fastened transversely on the inside, and making, when stretched on frame and rollers, a surface of 12 feet long and four feet wide, the inclination of which is altered to suit the material to be operated on by the screws G G. B is an inclined plane, divided into several channels, in connexion with the trough C, into which is placed the ore to be dressed, from which it is washed and distributed over the channel B. D is a shoot, over which clear water runs. E is a cistern, or receptacle, where the cleaned, or dressed, ore is deposited; and F, another, into which the dirt and waste falls. By the action of the water-wheel, the endless belt is made to move continuously upwards against the stream; and as the work is washed on the table overhead B, where the stream is increased by the clean water, which two streams combined are sufficient to wash the waste over the end of the frame into cistern F; while the ore, by its superior gravity, resists the force of the stream, and is carried upward, being (while passing between the heads B and D) subject to the action of the stream of clean water. When the ore, thus separated from the waste, is carried up past the head D, it is free from all action of water, and adheres to the canvas until it touches the water in cistern E, when it directly falls off, and is deposited in the bottom of cistern E. Thus there is a continuous stream of material to